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EDITORIAL NOTES.

The Jubilee Meeting, and Other Matters.

WE are now getting to close quarters with the Jubilee Meeting of the Institution; and, at last Tuesday's meeting of the Council, the arrangements were practically completed. The historical interest that attaches to the occasion will alone be a sufficient attraction to ensure a record attendance; and we feel confident that the President (Sir Corbet Woodall) and the Council will have the felicity of welcoming all those of the early members of the old modest-titled British Association of Gas Managers who can undertake the journey to town, as well as several guests who will come to offer congratulations on the completion of fifty years' service of the organization to the gas industry. Special attention has already been drawn by us to the social functions, which will include a dinner, and a garden party at Chislehurst, on the invitation of the President and Lady Woodall. At the meeting, too, we take it, the portrait in oils of the veteran gas engineer and life-long friend of the profession and industry, Mr. Thomas Newbigging, will be formally handed over, as well as the Birmingham Medal to the President.

The technical programme now calls for notice. The address of the President, we know from past experiences, will be a production that will ring with the fervour and beliefs born of vast and unrivalled experience of the work of our industry, present and past, at home and abroad. There will be the reports of the various Committees; but information as to their substance must await publication. Seven papers are listed; but one is only provisionally arranged for. We are hoping, however, that the uncertainty that the note appended to the title of the paper conveys will be quickly removed, as on this occasion no one would be more welcomed from the United States (and we believe he will not be the only visitor from across the Atlantic) than Dr. Alexander C. Humphreys, who holds such a large place in the affections and the work of the gas profession of America, and who is always welcomed by a large number of friends in this country. The paper which, it is hoped, Dr. Humphreys will read, will be on the subject of depreciation. The remaining six papers have each an independent distinction in respect of subject-matter. Carbonization in bulk in coke-ovens is a branch of technical work in which gas engineers are taking greater interest, in view of the larger dimensions of charges for gas production, the actual incorporation in gas-works operations abroad of coke-oven plant, the utilization of part of the residual gas of coke-ovens for town supply (more abroad than in this country), and the contribution that the residuals make to the markets in which the gas industry does business. Mr. W. Chaney, of Birmingham, will treat of the subject of carbonization in coke-ovens—the Birmingham Gas Department, as is well known, having an installation now, primarily for the supply of metallurgical coke for the city's industries. The Midland capital will be a good contributor to the proceedings on this occasion; for two other papers will be presented by technical members of the staff of the Gas Department. Dr. W. B. Davidson will deal with the subject of liquid purification; and we may rely upon him, judging by precedent, to put independent views from his experience and studies into the contribution. Jointly Mr. E. W. Smith and Mr. C. M. Walter will make a contribution on gaseous heating; and, for wide information on this matter, Birmingham is a source second to none, and the authors are best fitted to handle the subject.

The commercial work of a gas undertaking in promoting prosperity to-day rivals that of the technical department; and there will consequently be much attention given to the experiences and the views that the Controller of the Sales Department of the Gaslight and Coke Company (Mr. F. W. Goodenough) will incorporate in a paper dealing with the creation of an outdoor staff. The selection of the proper persons for an outdoor staff of a gas undertaking is no mean factor in commercial success. There are some interesting experiences to be extracted from gas supply during recent years in the suburbs of the Metropolis; and Mr. A. A. Johnston, of Brentford, has undertaken to discourse on certain aspects of suburban gas supply. Though not standing last in the list as submitted, and by no means least in importance in subject, there is also the paper that Mr. S. B. Langlands, of Glasgow, will read on the relation of ventilation to the use of gas. The report that we published from Glasgow on domestic gas heating in January, 1910, may be of interest in this connection. Glasgow has made a study of this subject; so Mr. Langlands may be looked to for some supplemental information concerning it. Touching the question he will open to discussion, it is noticed that a communication has been made to the Council by the Leeds University suggesting the appointment of a Joint Committee, composed of representatives of the University and of the Institution, to consider the desirability of conducting a research into ventilation. For this purpose, representatives of the Institution have been appointed. Regarding a kindred matter—factory lighting and ventilation, and their physiological and material effects—witnesses are to be selected to give evidence on behalf of the gas industry before the Home Office Committee on Factory Lighting.

Returning to the procedure at the annual meeting, and to the papers. We are glad to observe that at length the Council have made a serious move in dealing with the congestion of work at the sittings on the occasion of the annual meetings. The time hitherto occupied in the reading of papers is to be largely economized by a step that should have been taken long since. Copies of the papers, it is proposed, shall be available for members desiring them before the meeting; and, at the meeting, the authors will only read previously prepared abstracts outlining the contents of their contributions. There are two parties to this arrangement who can ensure it success. The first party is the author whose manuscript should be ready for printing well before the meeting; and the second party is the member who intends seriously to take part in the discussion on a paper, rather than on the excellence of the author and of his contribution. To do this, the papers, under the changed conditions, must be read by members before the meeting; and this will give an opportunity to those who join in the discussions to prepare pithy and pointed statements, and to shun wearisome discursiveness. Reverting to the authors' part in the new arrangement, there has been complaint on several occasions as to the delay in being able to secure copies of important communications prior to the meeting. This is not the fault of the printers. If authors will procrastinate in the preparation of their manuscripts till a few hours before the meeting, the printers cannot possibly do their part in setting the matter in type, in forwarding proofs for revision, in receiving them back again, in correcting them, and in finally printing them in pamphlet form in a condition fit for circulation among the members. This rush at the end causes errors to creep in, as well as involving increased expense; and the whole matter is rendered unsatisfactory—solely owing to the belated action of some authors. We hope the hint will be taken on this occasion, when, under the new order of things, the manuscripts of papers will all be required at an early date.

Everything, so far as the programme is concerned, is now well in train for the annual meeting; and everything points (given good weather) to the success of a meeting of superlative interest in the annals of British gas engineering and management.

The Incomplete Street-Lighting Specification.

THE street-lighting specification made its first public appearance last Tuesday evening at a meeting (held under the auspices of the Illuminating Engineering Society) of representatives of the bodies concerned in the subject; and it is going to be introduced for a second airing next Tuesday. The specification is a defective thing in its most important part; and in the other parts, there is not much that one would not insert nowadays, in the ordinary course of things, as conditions in any contract for public lighting. We do not say this, nor what we have yet to say, in any disparagement of the efforts of the members of the Joint Committee, who have given much time and labour to the matter; nor in any disparagement of the masterly paper that Mr. A. P. Trotter prepared, and brought before the meeting to serve as a basis for discussion. The Committee have done their best in trying to place under definite prescription in regard to illumination street conditions that are as wide asunder as the poles, and diverse means of lighting that are widely dissimilar in their illuminating effects. Though admiring right from the outset the pluck and assiduity of those who took this matter in hand, we felt that only failure could ensue; and failure to realize a complete specification, and one that is fair to all illuminants and to the public, is written all over the result that is before us to-day, though the majority—and that majority our electrical friends—will not admit it. However, there is satisfaction in the attempt having been made; it has long been talked about. But the difficulties have become more formidable the farther the matter has been pressed forward. As it is, the specification that is before us to-day is only a draft one, submitted for the purpose of discussion, to ascertain whether there is a chance of some modification whereby it may go before the Councils of the various bodies represented on the Joint Committee with the impress upon it of a unanimous acceptance by the members of the latter. But we hardly think, however much talk there is on the subject, that the specification as it now stands could be generally accepted without radical modification. Granted, it is about the best thing that could be put forward on behalf of the electrical industry. It suits its lighting conditions *in toto;* but it does not suit so well the means of lighting presented by the gas industry, which means of lighting better suit the general conditions of streets, and the requirements of the users of streets.

The Joint Committee, in effect, admit their failure to produce a complete specification, applicable to all streets, upon the illumination of which lighting authorities find it necessary to place some sort of limit in the matter of expenditure. Let us look into this. There are three main conditions in the specification. In the first place, minimum foot-candle illumination has been adopted as the criterion of satisfactory lighting for classes of streets ranging from "A" to "E," and the foot-candle minima range from 0·01 to 0·1. Secondly, it is proposed that the illumination shall be measured on the horizontal plane. The third condition is that the measurement shall be made 3 ft. 3 in. (say, 1 metre) from the ground-level. At the meeting last Tuesday, the representatives of the gas industry did not raise any strong objection to the minimum foot-candle illumination suggested for prescription for various grades of streets; nor did they take any exception to the height from the ground surface at which it is proposed that the measurement shall be made. But the three principal speakers who voiced what may be taken as the views of the gas profession—Mr. Robert Watson (one of the members of the Joint Committee), Mr. J. G. Clark, and Mr. Franklin Thorp—were agreed in objecting to the horizontal plane illumination condition; and to convince them that they are wrong will require more than the coincidence of the eye selection and classifying of a certain number of streets by a few experienced borough surveyors, and the classification resulting from minimum illumination tests on the horizontal plane by three electrical members of the Committee, much more than the table prepared by Mr. Haydn Harrison, which has given Mr. Franklin Thorp (as our report shows) some food for reflection, and very much more than the refreshingly volatile treatment of the subject shown by Mr. Edgcumbe.

However, in selecting minimum illumination as the standard, and dissociating it from all else, we have the first two defects in the specification. The lowest minimum illumination prescribed is 0·01 foot-candle; and the Joint Committee (or rather the majority responsible for the terms of the draft document) acknowledge that 80 per cent. of our lamp-lighted streets cannot come within the specification, owing to the fact that the minimum illumination found in them is below 0·01 foot-candle, and so cannot be measured. It is quite possible that the illumination in those streets is quite sufficient, and that it would be waste to spend more money on them than is expended now. But we know that there is a good percentage of the 80 per cent. that could be improved, for a comparatively small expenditure per mile, by the application of modern gas-burners. However, that by the way. The specification in the very part—illumination—that caused the inception of the movement for a specification can have no greater application than to 20 per cent. of the thoroughfares artificially illuminated at dusk; and candle-power measurements will still have to apply to the remaining 80 per cent. Therefore, if the Joint Committee's specification be adopted, in one-fifth of the streets a minimum illumination test would be the basis of contract; and a candle-power test of the source of illumination in four-fifths of the streets. In the case of public-lighting contracts, it is just as well to have as little complication as possible. But while minimum illumination is defined, there is no prescription as to what shall be the maximum illumination in a street. In effect that is another defect, as the diversified illumination that may obtain in any street through an extreme maximum and a low minimum, may be of a character that is out of all harmony with the idea of street illumination being brought on to more governable lines than hitherto. Maximum illumination, too, may be as intolerable as a very low minimum. In the recent Manchester tests, we saw that the candle power of the flame arc lamps was considerably higher than the candle power of the high-pressure gas-lamps; and yet the minimum illumination from the latter (defectively equipped though they were) was practically the same as that of the flame arc lamps, which showed that there was a better diffusion of light by the high-pressure gas-lamps than by the electric arcs. It is not till one comes to streets with a lower minimum illumination than 0·01 foot-candle, that the specification says anything about the heights and distances apart of the lighting units. Yet tremendous differences may be produced between maximum and minimum illumination, by freedom in all matters but the minimum; and those differences would afford the best possible testimony to the need not only of a Society that studies scientific illumination questions, but one that is active in defending the principles of scientific illumination.

Then, further, although the gas-engineering members of the Committee do not raise any strong objection to minimum illumination being the basis of the specification, the quantitative determination of the minimum illumination is no real measure of the illumination in a street. This was a point that Mr. Jacques Abady dilated upon at the last meeting of the Institution of Gas Engineers; and he showed that minimum illumination could not well be considered without reference to other factors. One seems to want something more than minimum illumination as a test; otherwise pure variations in local or atmospherical conditions may do an injustice to a contractor and to his lamps. Lamps, giving perhaps the full, and more than the prescribed minimum illumination in one place, may, though equipped in precisely the same manner, and maintained equally as well, produce in another location with different conditions something that falls short of the minimum. The prescription of minimum illumination, too—particularly down to such a point as 0·01 foot-candle—does not for penalty testing purposes provide scope for a working margin, including the errors that long photometrical experience testifies are introduced by the personal element in such work. Moreover, the question of qualitative illumination, as distinct from quantitative, is quite ignored by the specification. The deficiencies of the specification are so many that we can only regard it as a very defective instrument for the purpose for which it is designed.

In other columns is published a fairly full report of the long discussion that took place at last Tuesday's meeting. The subject is of importance, as there is no doubt that we are on the threshold of new contractual conditions in connection with public lighting. Westminster and other important Metropolitan quarters have given the lead. It is felt that, if there is to be anything in the nature of a model specification for those making contracts either as lighting authorities or as suppliers of the agents used in public lighting, the model may as well be one which will be fair both to the suppliers and to the purchasers of the illumination. It can well be conceived that, in the conditions laid down in

such a model, the interests of public and supplier may clash, through defects in the agents by which the suppliers carry out their contracts. It was on the point of testing conditions and not the actual standard that the opposition—representatives of the gas industry, and led by Mr. Watson—took a very definite and firm stand last Tuesday, as the members of the Institution of Gas Engineers on the Joint Committee have done from the first. They do not consider, and we think they are right, that measurements on the horizontal plane are the best for lamps giving different polar distribution curves, or for lamps at different heights and location; nor have such measurements any clear relationship with the purposes for which artificial illumination is required by the public in the streets. Those purposes are of a diverse character; and the majority have reference to (if we may so term it) the vertical plane. Whether one is walking or riding, it is natural to look ahead; if we want to see the faces of pedestrians, we are looking at a perpendicular object; if we want to ascertain where an omnibus or tram is going, the information on the front, back, and sides is all printed on something in the vertical position; shop windows and houses are all vertical; we are looking at something on a vertical plane when ascertaining printed names over windows, or numbers over doorways; the clocks in the streets have their faces all vertical; and so have mural notices—such as posters. But the majority of those on the Committee who have made a real study of these matters are electricians. They know that the horizontal plane is the best possible for their lamps, owing to the angles of the useful rays; they know, too, that the better distributing power of gas-lamps of equal candle power, and even somewhat below, gives gas an advantage in meeting the several requirements in street lighting. The point was shown clearly in the Manchester high-power lamp tests, as also in the lower power lamp tests (officially made) in Holborn, in both of which instances the gas-lamps started with a lower initial candle power, and gave equal or higher minimum illumination. Mr. Watson and the other speakers asked that direct-ray foot-candle valuations should in future be adopted. The arguments are found in their speeches; we will not repeat them. But it was noticeable that, though other speakers announced their affection for the horizontal plane, there was not one who produced any argument showing that the advocates of direct-ray measurement were wrong. We cannot see how they could do so. Mr. Watson suggested that the specification should contain direct-ray measurement as an "alternative" to measurement on the horizontal plane. We see objections to alternative methods—one method claimed by one contractor, and one by another. The alternative would raise all sorts of difficulties. Why not adopt the method that has consonance with the greater number of requirements of the organs of vision when the owners of these organs are in the streets? We are afraid that on this point we shall not get the electrical people to see the same as the gas people. Commercial interests stand in the way, and those interests are electrically more important than is scientific cause.

We hope that as many gas men as possible will be present at the further discussion of Mr. Trotter's paper at the Society of Arts next Tuesday.

A Visit to Birchenwood Colliery.

It was recently remarked in these columns, when advocating the admission into our gas organizations of the technical men associated with coke-oven and bye-products plants, that there was much that those who carbonized coal primarily for the production of gas and those who carbonized coal primarily for the production of metallurgical coke could learn from each other. This view is accentuated after the joint visit paid last Saturday afternoon, by members of the Manchester Institution of Gas Engineers and of the Manchester Junior Association, to the extensive works of the Birchenwood Colliery Company, where coke-oven and bye-product work is conducted on the most modern lines, and with plants that, both for magnitude and excellence, stand well to the forefront in this country. This visit of senior and junior gas men is an innovation in District Association work; and, after witnessing the helpful effects of intermingling on special occasions such as this, we feel that united visits should be encouraged. That by the way, however. The visit at this time originated in the fact that Mr. D. V. Hollingworth, F.C.S., the ex-President of the Manchester Juniors, who is in charge of the "Carl Still" coking and bye-products plants at the Birchenwood Colliery, was unable to arrange one during his year of office. But the delay was to the profit of the visitors, for they saw the full magnificence, through its completion and working, of the plant for coking and bye-product recovery which the Company have laid down during the past four-and-a-half years; and they saw it under the best of circumstances, inasmuch as the General Manager of the Company (Mr. James R. L. Allott), who showed a great personal interest in the visit, and the colleagues of Mr. Hollingworth—especially Mr. J. West, the Manager of the Simon-Carvès coking and bye-product plant, which is the older of the two—one and all generously laid themselves out to show everything that could be seen in a short afternoon, and give the members as many details as possible in the time at disposal. Just as there was no stint in the personal attentions of these gentlemen, so there was no stint in the information imparted. The whole visit was a technical treat, as the descriptive article elsewhere more particularly shows.

But there was one thing that was striking. Here is a long-established Colliery Company, the surface of whose estate but a few years ago bore only such buildings and means of transport as were necessary for the coal business. But the surface has, during the past four-and-a-half years, undergone a complete transformation, by the construction of the huge coking and bye-product recovery and chemical plants, together with gas-producer and electricity generating plants. This has been a big engineering work; and Mr. Allott was heartily congratulated upon what the Company had succeeded in doing. All the coal now raised from the colliery is coked, and the residuals are worked-up to the fullest measure within economical limits. When coking and bye-product operations of such magnitude are witnessed, the question naturally arises, Are they likely ever to be carried to such a length that injury will be done to the gas residuals market? We think the reply may safely be in the negative. As a matter of fact, we rather fancy the coke-oven industry is more likely to fear—if there were ground for any fear—the unknown future of the gas industry. The development of the coke-oven bye-product business must be limited to the demand for metallurgical coke; while the gas industry's residuals production is limited to the demand for gas. But what that demand will be in future no one can foretell with the growth of application that is going on all around. As it is, the fields for the utilization of the residuals and the derivatives therefrom are continually expanding; and, though not in consequence, it is a fact that during the existence, and during the most active period in the existence, of bye-product recovery at colliery coking plants, market prices have been better than ever. As we have said before, it is to the interests of both the gas industry and the coke-oven bye-product industry that they should work together in fostering the development of markets for their secondary produce, and in maintaining and attempting to still further improve the conditions of the markets already possessed.

The Industrial Gas Branch.

The gas industry everywhere is out for business, and an increasing amount of it. The industrial load is a profitable one to cultivate, because, as a rule, it is continuous during the day and the demand lessens as the heavier lighting load comes on. Greater attention is being paid to the potentialities of this load than was at one time the case; but there is still missing in many places a systematic dealing with this branch of business. The Philadelphia Gas Company have a highly organized and systematized department for giving special attention to the industrial gas requirements of the city; and they find their methods very successful and profitable. They are to be congratulated on the results, with industrial gas at $1 per 1000 cubic feet. This price (as we consider prices at home at which gas must be supplied for industrial uses) is an eloquent tribute to the system upon which the industrial gas business in Philadelphia is being developed and maintained; and there is indebtedness to Mr. J. S. Welch for letting the gas industry know, through the paper he read before the American Commercial Gas Association, the main structural lines of that system.

There can be no rigid formulæ in regard to methods for the development of industrial gas sales. Methods have to be tempered by diplomacy in order that the worshippers of tradition and custom, or those who have a predilection for some other method of heating or of driving, may not be antagonized by what might appear to them to be the

dogmatic attitude of gas men. There are, however, broad fundamental lines on which an industrial business getting and maintaining system can be developed. The most important constituents in that system are the men and their knowledge. In this special work just any man will not do. His personal qualities must be those which we all recognize as essential in the trading world. He must be commercially trained; and he must have technical accomplishments, and be able to enter intelligently into the technical needs of the manufacturer. Unless he can do this, it is impossible for his advice and recommendations to set squarely against the requirements of the prospective customer.

At Philadelphia, the Company ensure that their industrial salesmen are not wanting in technical efficiency. What better training, in addition to the commercial, can a man have for such work than by taking, before he is sent out, a course of practical work in the appliance, inspection, and repair departments? The industrial gas salesman there is competent to take a gas-engine to pieces, assemble the parts again, and put the engine in running order. He is able to take upon himself the responsibility of recommending the type of appliance for use, and of ascertaining that the gas-delivery pipes of an establishment are sufficient for the purpose. He is competent on a visit of inspection to locate defects if there are complaints, and to give instructions for their remedying. Industry does not want to wait in these matters for compliance with the circuitous and monotonous routes mapped out by red-tapism. The Philadelphia Gas Company are alive to this; and so they make their industrial salesmen qualified and responsible agents of an all-round order. They also ensure that their men shall know their competitors. An idea exists in some minds of shallow comprehension that it is not necessary that those who have to discuss gas affairs with consumers (who possibly have been already primed by the agents of one or more competitors) should trouble themselves about acquiring knowledge of those competitors. A greater mistake never existed; and the educational policy of the Philadelphia Company is in agreement with our view.

There are many parts of this Philadelphian industrial gas system described in the paper—among them being the frequent and thorough inspection that takes place after the installation of appliances. Indeed, from installation throughout life, the Company take a direct interest in the welfare of every industrial gas appliance in the placing of which they have had a hand. The results justify the comprehensive system. In 1911, the increase in the industrial consumption of gas was 12½ per cent., or 44½ million cubic feet. In that year the gas-engine sales amounted to 188,855,400 cubic feet; and 221 engines were also sold. The consumption per brake horse power per annum has increased from 15,100 cubic feet in 1909 to 23,700 cubic feet in 1912. Information of this kind, as to the material effects of the operation of a well-ordered system of developing and maintaining a special line of business, does more to encourage the wider adoption of similar methods than any other form of presenting the case would do.

The German Gas Industry.

Germany possesses a Society for the Promotion of Industries; and before the members Dr. A. Sander lately read a paper on the "Technical and Economic Development of "the Gas Industry in Germany." The paper is highly informative; and we are inclined to say that in one respect it is also deceptive—not intentionally so, but owing to the influence of whole numbers and averages. Through its work—more especially during late years—Germany has taken a large part in the technical development of the gas industry, and, through the technical work, in its economic advance. But if the gas industry of Germany is taken as a whole, and if the whole had worked more on the lines of the British gas industry some years since in developing its commercial interests, there would have been a still greater economic advance than there has been. It is upon this very point that we consider Dr. Sander's paper a little misleading, in that the whole and average figures do not discriminate between those gas undertakings that have been progressive, and those that have retained the traditional dormant policy. We see that there are about 1400 gas-works in Germany, compared with rather more than 1600 (statutory and non-statutory ones) in the British Isles. The consumption of coal is about 7½ million tons, which is used for making 89,000 million cubic feet of gas. It may be taken that the gas undertakings of the United Kingdom use about 10 million tons of coal in excess of the German undertakings, not taking credit for any equivalent represented by the production of carburetted water gas.

But the point that is evidently, in Dr. Sander's eyes, the blot upon the German gas industry is that the average consumption per head in the gas-supplied cities and towns is only 2365 cubic feet; but there are towns where it is much higher—for example, 6640 cubic feet per head in Charlottenburg, and about (in 1910) 6000 feet in Berlin, according to Mr. W. J. A. Butterfield, in his recent lectures before the Institute of Chemisty. The statutory gas undertakings of the United Kingdom claim an average consumption per consumer of 28,500 cubic feet, or (say) between 5000 and 6000 cubic feet per head of the population in the cities and towns represented, which means that some can boast considerably more than that per head, and some less. But the low average of 2365 cubic feet per head in Germany does not strike us as at all fair to the undertakings that are progressive. Take, for instance, the forcible propaganda work that the Imperial Continental Gas Association—an Association which helped to plant the gas industry in Germany—are engaged in at their various stations. We know, too, something of the spirit that pervades the management of the German Continental Gas Company, and the administrators of other enterprising gas undertakings in certain German cities. It would be unfair for these to be judged by any standard such as the average figure of 2365 cubic feet, for it would entirely misrepresent the facts. At the same time, even the concerns and cities in mind were in the rear of this country in prosecuting prepayment meter supply and the use of gas for cooking among the artizan and labouring classes, as well as domestic gas-heating generally. But they have been for some time pressing forward. There is a good field before them, and great promise.

Determination of Water in Coals.

It will be seen, from information published elsewhere in this issue, that our chemical friends are seriously taking up the question of the standardization of the methods of determining water in coal. The matter came before the International Congress of Applied Chemistry at Washington, in a report presented by Dr. Rudolf Lessing, and prepared by the President (Mr. G. T. Holloway) and the Vice-President (Mr. J. H. Coste) of a Sub-Committee specially deputed to consider the question. If the Sub-Committee can arrive at a system of standardization which could be universally adopted, they will have done an excellent service for those who buy coal, and those who have to ascertain the amount of moisture in coals. The fact that the Sub-Committee had this particular matter referred to them is sufficient evidence that the various methods in existence and applied are suspect by the most competent judgment. It is due to the several loopholes there are for error in making determinations that one feels hesitation at times in accepting reported results. Some laboratory workers, we know, look upon the determination of moisture in coal as one of the easiest of the tests they are called upon to make, whatever the method they are in the habit of using; and they are only persuaded as to the elusiveness of results when a sample of coal is taken, and two or more observers in the same laboratory, at the same time, and working under the same conditions to obviate any error due to extraneous causes, make tests, and then compare their discrepant results. There is really at present great difficulty in making determinations that can be taken as conclusively accurate; and, though the matter appears to be so simple, there is still much to be learned about the general subject of water in coal—such as the various characteristics of coal which favour water absorption, which allow coal to part readily with its moisture, and so forth. The whole subject is important, as coal users do not care to buy more water than they can help through the medium of coal, nor do they want to pay for the carriage of high percentages of water. We hope the Sub-Committee will pursue their work, for though their report is long, and their recommendations several, the latter can only be considered as tentative, and by no means as indicating finality. Acknowledging that this is so, further emphasizes the scant confidence existing in the present methods by men accustomed to their use.

Some Thoughts on Trade.

"There are some good things that only become evil by being pursued to extremes; and as a rule the men who are the most

dangerous to the commonwealth are those afflicted with an obsession or an 'ism'—'isms' which obscure the judgment, and obsessions which blind and prejudice in some given direction, to the injury of the community at large." This was a statement, followed by "practical illustrations," put forward by Mr. S. T. Nicholson, the Hon. Secretary of the National Chamber of Trade, in a speech delivered at Oxford. The first of the illustrations adduced by him in support of the soundness of his argument was that of municipal trading. In connection with this form of enterprise, it seems the Chamber of Trade consider that public monopolies requiring the use of the streets for wayleaves describe roughly the limits within which it may be usefully conducted; but, he then added, if they tested even such agreed trading upon business principles, they came upon a distinct and definite warning against further encroachments on individual enterprise.

The Exceptional Position of Oxford.

Readers who study the annual rating statistics of Mr. James Carter, of Preston, which are regularly noticed in our pages, will be aware that Oxford occupies an altogether exceptional and enviable position in the matter of low rates; and this was a point referred to by the speaker, who took occasion to draw attention to "the remarkable paradox that towns and cities where municipal trading exists are the most highly rated in the country"—or, to put it more strikingly, that "where the rates are most 'relieved' by municipal trading experiments, there the rates are highest." In the opinion of Mr. Nicholson, the weakness of municipal trading exists in the very heart and centre of its operations; and it is depreciated, if not doomed, by the absence of legitimate incentive and due reward, and by the presence of the apathy and indifference that have wrecked every socialistic experiment throughout the whole range of history. While admitting that municipal schemes relating to the supply of gas, water, or electricity, &c., should be weighed upon their merits, the conviction he was desirous of driving home among his audience was that the results of general experiment are dead against municipalizing the ordinary supplies for human consumption which is advocated in many directions.

The Promoters at Work Again.

Some of the Cannon Street promoters who were identified with Mr. Eaton in his notorious work (and probably are now) are circularizing the public again, and particularly ladies, for more money. The position of the oil market, and the search for a substitute for petrol, has given them a new opening; and they are using that old instrument of theirs—the Patent Block Tar, Motor Fuel, and Asphalte Company—for this particular purpose. A circular headed the Oil-Fuel Securities Investment Company, and addressed from No. 115, Cannon Street, E.C., offers shares in the "Parent Company" to "Dear Madam," including 10 per cent. interest, together with suggestions of a wonderfully lucrative return. The "Parent Company" is, of course, the Patent Block Tar, &c., Company, Limited, which has not yet got far on the road, though not young in years in one form or another, in making fortunes for anyone who has been so imbecile (outside the promoters) as to place money in it. Some twelve months ago, circulars came to hand similar in character to those now being distributed by the Oil Fuel Securities Investment Company, and the Patent Block Tar, &c., Company; but the current ones have been revised, extended, and made more attractive. It is unnecessary to warn our readers against having anything to do with either of these concerns, or to be captured by the specious form in which the offer of shares is made. When the similar circulars reached us nearly twelve months ago (notice was made of them in the "JOURNAL" for May 21, p. 497), Mr. H. W. L. Way, J.P., was the Chairman of the Patent Block Tar, &c., Company; and Captain John Maclean—a staunch adherent of Eaton in his promotions—was Deputy-Chairman. Captain Maclean is now stated to be the Chairman. It is unnecessary to comment on the new features of the circulars.

An Outside Statistical Review.

An editorial article has appeared in the "Contract Journal" dealing with the returns relating to statutory gas supply in the United Kingdom. The facts presented by such returns are hard, irrefutable things; and there is no getting away from the history of perennial progress presented by them. The picture that our contemporary is therefore able to place before its readers is a bright and congratulatory one. It shows, in the first place, that national development permits of two large competing industries—gas and electricity—making substantial and unceasing progress side by side. There is one thing that the reviewer of the industry's prosperity apparently does not understand. It is that the price of gas should vary so considerably in different districts. Several adjoining places are instanced where prices vary fairly substantially. It may be pointed out to our contemporary that size of concerns, extent of business, character of area, and convenience for coal getting and selling of residuals are factors in this; and if the matter be looked into closely, it will also be found that capital per unit of business done plays an important part in the variation. Where capital is heavy, it is usually found that it is due to past administration, and that the heavy burden of producing relief has been passed on to the present administrators. Under statutory control, this is a slow process; but in some cases more might be done than is done at the present time. One other point in our contemporary's article is a measure of surprise that Redruth, associated with the life and work of Murdoch, is not represented in the returns; and this leads to the remark that "apparently there is no gas supply at Redruth." Our contemporary is obviously unaware that there are as many non-statutory gas concerns in the British Isles as statutory ones; and all these non-statutory ones are excluded from the returns. Many of them are small, and privately owned. Redruth has a gas supply; and the undertaking is owned by Mr. A. Lanyon. Besides there are thousands of districts and villages that have no independent supply, but are within the gas limits of a neighbouring town. Such places would not appear in any list of statutory or non-statutory concerns.

Forthcoming Congress of the Société Technique.

Circulars have been issued to members of the Société Technique du Gaz en France relative to the annual congress, which will be opened at Toulouse on Tuesday, the 17th of June, and extend over the rest of the week. The President this year is M. Boutan, Managing-Director of the Lyons Gas and Electricity Company. The morning of the first day will be devoted, as usual, to the routine business, such as the admission of new members, the reception of the reports of the Committee and the Treasurer, and the nomination of the Committee for the ensuing year. In the afternoon, the President will deliver his Inaugural Address, the usual distribution of medals and awards will be made, and some of the papers submitted for consideration will be taken. The morning and part of the afternoon of Wednesday will be given up to papers; and at four o'clock the members will visit the gas-works. On Thursday the rest of the technical business will be disposed of; and in the afternoon M. Sabatier, Dean of the Faculty of Sciences, and the holder of the Nobel Prize for Chemistry for the present year, will read a paper. In addition to the communications, there will be discussions on the following subjects during the meeting: (1) Washing of clinkers and utilization of combustible residuals; (2) employment of small coke in gas generators and appliances for use in central heating; (3) use of gas in the food industry. The social functions at the meeting will be of a very interesting character. On the evening of the first day, the members will be the guests of the Centre and South of France Gas Company; and the next evening the banquet of the Society will be held in the Grand Hôtel et Tivollier. On Thursday evening, the members will leave for Luchon, where they will pass the night. On Friday, they will go by cog-railway to Superbagnères, partake of luncheon there, and return in the afternoon to Luchon for Toulouse, where they will separate. Supplementary excursions will be arranged for Saturday and Sunday to places in the Pyrenees, provided a sufficient number of the members will join them.

North of England Gas Managers' Association.—The seventy-second half-yearly meeting of the Association will be held in the Lecture Theatre of the Institute of Mining and Mechanical Engineers, Newcastle-upon-Tyne, on Saturday, the 3rd prox., under the presidency of Mr. C. H. Armstrong, the Secretary of the Walker and Wallsend Gas Company. We learn from the circular issued by the Hon. Secretary (Mr. Herbert Lees, of Hexham) that the members will assemble at half-past eleven for the transaction of the business upon the *agenda*, which comprises a discussion on the paper by Mr. R. Nelson, on "Extensions to Carbonizing Plant at East Hull, with Notes on Working Results," read at the spring meeting last year; a paper by Mr. A. B. Walker, the Engineer and Manager of the Walker and Wallsend Gas Company, on "Results of Concentration of Works;" and the revision of the rules, the election of office-bearers, and the settlement of the place of next meeting. At the close of the business, luncheon will be served in the County Hotel.

PERSONAL.

Professor C. W. L. Alexander, of University College, Cork, has been awarded by the Council of the Institute of Civil Engineers of Ireland the Mullins Gold Medal for his recent paper on the design of water-pipes and culverts.

Mr. Stephen O'Mara, who has been elected to fill the vacancy on the Gas Committee of the Limerick Corporation, due to the death of Mr. William Lloyd, is an ex-Mayor of the city, and his experience will be of great value in reference to the development of the gas undertaking.

Mr. B. W. Gothard, A.M.I.E.E., the Engineer and Manager of the Minehead Electric Supply Company, has been appointed on the General Manager's (Mr. R. W. Edwards's) technical staff, to take charge of the electricity department of the Aldershot Gas, Water, and District Lighting Company.

Mr. Percy Drewett, who, as already announced, has been appointed Manager of the Fareham Gas Company, has been presented by the staff and employees with whom for some years he was associated at the Winchester Gas and Water Works with a silver watch, a silver cigarette case, and an umbrella. The presentation was made by the Company's Engineer and General Manager, Mr. H. C. Head.

Mr. G. A. D. Mackay, who has been for a number of years Inspector of Cleaning and Lighting in the city of Edinburgh, and who has recently had to retire on the score of age, was presented with his portrait in oils and a cheque for £75. Mr. Mackay was responsible for the adoption of the inverted burner throughout the street-lamps of Edinburgh, and the city was one of the first places to recognize the greater strength and longer life of the inverted burner mantles. Another improvement which Mr. Mackay instituted was the use of small inverted burners, of the bijou type, made in cast iron, for lighting the common stairs of the flats which are so much in vogue in the city. The burners, which in many cases take the place of a single rat-tail jet, were the patent of Mr. Alexander Wilson, of Glasgow.

OBITUARY.

DR. SCHNIEWIND.

The last number received of the "Gas Age" (New York) records the death of Dr. F. W. C. Schniewind, who, as many readers are aware, was interested in the bye-product coke-oven process, and was the representative in America of Dr. C. Otto and Co., of Dahlhausen. About the year 1894, the Otto Coke and Chemical Company was organized to introduce ovens of their type into America; and one of the earliest plants to be erected was installed at Glassport (Pa.). Dr. Schniewind was the Chemist and Superintendent; and his association with the gas industry may be said to have commenced at that period. The United Coke and Gas Company was organized to succeed the original Company; and in 1898-9 the 400-oven plant at Everett (Mass.)—the largest at that time—embodying the principle of the division of gases, was built. The results of Dr. Schniewind's researches were presented to English engineers in his paper on "The Production of Illuminating Gas from Coke-Ovens" read at the International Engineering Congress at Glasgow in 1901. The paper aroused much comment; but it is stated that nearly all the coke-oven plants in the United States, where it is commercially feasible to dispose of the illuminating gas, now operate on the principle laid down. Dr. Schniewind was Consulting Chemist to, and subsequently Manager and Vice-President of, the United Coke and Gas Company; and at the time of his death he was President and sole owner of the German-American Coke and Gas Company and its subsidiary Companies (the United Coke and Gas Company and the American Coke and Gas Construction Company), as well as President of the newly-organized Schniewind Coke-Oven Company. He was also a Director of the Rotary Meter Company. His name was on the membership roll of the American Gas Institute, the National Commercial Gas Association, the American Illuminating Engineering Society, and a number of other American and foreign technical and scientific bodies. He was in his fifty-second year, and is survived by a son and infant daughter.

Mr. Butterfield's Lectures on "Chemistry in Gas-Works."—It will probably be remembered that towards the close of the past and early in the present year two lectures on "Chemistry in Gas-Works" were delivered by Mr. W. J. A. Butterfield, M.A., before the Institute of Chemistry, of which he is a fellow. The lectures, which were noticed in the "Journal" at the time of their delivery, have been issued in pamphlet form, and we have received a copy from the Registrar and Secretary (Mr. Richard Pilcher). The text occupies 70 pages, and there are five plates—two folding ones at the end of the book being a diagrammatic plan of gas-works and cross sections of the Dessau, Woodall-Duckham, and Glover-West vertical retorts. A list is given of the exhibits used to illustrate the lectures. The pamphlet is supplied free to fellows, associates, and registered students of the Institute; but it may be obtained by others, at the price of 2s. 6d., from the Offices, No. 30, Bloomsbury Square, W.C.

ANTWERP GAS EXHIBITION.

Presentation to Mr. Hayman and the Executive Committee.

On Saturday, the 12th inst., a pleasant ceremony took place at the offices of the Compagnie du Gaz d'Anvers, Place de Meir, Antwerp. Mr. W. Zeyen, in the name of the exhibitors at the gas exhibition recently held in Antwerp, presented a handsome bronze figure, representing Dawn, as well as a silver medal and an address to Mr. A. F. P. Hayman, the Engineer and Manager for the Imperial Continental Gas Association in that city. At the same time silver medals were presented to all the members of the Executive Committee.

Mr. Zeyen, in a short speech, expressed the great appreciation of the exhibitors for the work of Mr. Hayman and the members of the Committee. The motto *Ex Tenebris Lux* had truly been well chosen, for from nothing at all they had organized this exhibition which had been useful and profitable to all, and which would remain a pleasant memory for all who had participated in it. By the practical way in which they had set about the organization and all that was connected with it, they had given the exhibitors an opportunity which had far exceeded all expectations, and had rendered real service to the various industries in which these exhibitors were the specialists. Further, they had grown to understand one another better by seeing each other daily at work; and this daily contact had also shown them how truly difficult had been the task of Mr. Hayman, and what credit was due to him for understanding so well how to tackle it. This was why, at the close of the exhibition, the participators had determined to offer to Mr. Hayman and his colleagues some tangible souvenir, as an expression of their esteem and gratitude. The bronze figure, he would notice, was symbolical of the only real competition before which all those who fought against darkness voluntarily bowed the knee every day. In handing him this figure of Dawn, it was their hearty wish that Mr. Hayman might always be at the dawn of new successes, both for himself and for the powerful company whose destinies he so ably and tactfully guided at Antwerp. In the name of the same exhibitors, continued Mr. Zeyen, and with the same sentiments, he begged the members of the Committee to accept their modest souvenirs. Each in his own sphere had done his utmost, and the exhibitors offered them their heartiest congratulations and thanks.

Mr. Hayman, on behalf of himself and the members of the Committee, thanked the exhibitors for their kind appreciation. It was true they had worked hard, but had it not been for the hearty co-operation and help of the exhibitors themselves, the task would have been harder still. They had all pulled together so heartily that the success of the exhibition was due to them as much as to himself and the other organizers.

INSTITUTION OF GAS ENGINEERS.

Notes of Last Week's Council Meeting.

A Meeting of the Council of the Institution of Gas Engineers was held at the Offices, No. 39, Victoria Street, Westminster, on Tuesday, the 15th inst.—the President (Sir Corbet Woodall) in the chair.

A letter was read from the Engineering Standards Committee, reporting the resignation of Mr. James W. Helps, who represented the Institution on the "Sectional Committee on Screw Threads and Limit Gauges," and asking for the nomination of a successor. The Council unanimously nominated Mr. Alexander Wilson for the position.

A number of applications for membership were considered, and names approved for inserting in the next ballot-list.

It was unanimously resolved to award the Birmingham Medal to the President, in recognition of the distinguished services he has rendered to the gas industry.

Nominations for officers and members of Council for the year 1913-14 were made; and the names of those appointed to serve as District Members of Council were announced.

Reports of the following Committees were presented and adopted: Finance, Carbonization, Parliamentary, and Education and Certification of Gas-Fitters.

The programme of papers was completed and other arrangements for the annual meeting made. Papers on the following subjects are to be submitted:—

"Coke Oven Carbonization," by Mr. W. Chaney, of Birmingham.
"Liquid Purification," by Dr. W. B. Davidson, of Birmingham.
"Creating an Outdoor Staff," by Mr. F. W. Goodenough, of London.
"Notes on Suburban Gas Supply," by Mr. A. A. Johnston, of Brentford.
"Ventilation and Gas," by Mr. S. B. Langlands, of Glasgow.
"Gaseous Heating," by Mr. E. W. Smith and Mr. C. M. Walter, of Birmingham.
"Depreciation," by Dr. A. C. Humphreys, of Hoboken, N.J.*

* This is only provisionally arranged for.

The report of the Committee on the question of procedure in the reading and discussion of papers was presented and adopted. A departure will be made this year from the usual practice. Authors of papers will be asked to prepare an abstract for reading, and members of the Institution will be requested to make application for copies of the papers, and to notify the Secretary if it is their intention to take part in the discussion, and thus leave more time for the members generally to speak on the papers as submitted.

A letter was read from the Secretary of the "Home Office Committee on Factory Lighting," asking for the nomination of witnesses to give evidence before the Committee; and the Council decided to comply with the request.

A communication was received from the Leeds University, suggesting the appointment of a Joint Committee, composed of representatives of the University and of the Institution, to consider the desirability of conducting a research on ventilation. Four representatives of the Institution were appointed in view of the formation of the Committee.

THE SIMPLICITY OF GAS.

THERE are few conditions in which gas can be truthfully said to be out of place; and among all the circumstances to which it is peculiarly appropriate, the annual Simple Life and Healthy Food Conference and Exhibition must take a front place. Gas is simple, and as has been demonstrated times without number it is healthy; but these are facts which require to be continually driven home. Among some of those essaying the "simple life," there may still remain a lingering prejudice against it; for prejudice is a thing that dies hard. If it does exist, it must eventually succumb; but its end may doubtless be accelerated by a judicious use of the powerful weapon publicity. One may safely surmise that it is some such line of reasoning as this which leads the Gaslight and Coke Company to make at the exhibition referred to one of those attractive little displays in which they are adepts. Last week's show, which was held in Caxton Hall, Westminster, was the fourth of the series; and during the four days which it remained open a very satisfactory attendance was secured. In fact, the hall, though of a fair size, proved none too large to accommodate both visitors and exhibitors. The list of patrons of the exhibition included a number of well-known names; and the same remark applies to the lengthy programme of lectures. It is, however, only incidentally that the general arrangements call for mention here.

What the writer journeyed to the exhibition to see, and what he saw first of all—for it was in the most prominent position, facing the entrance door—was the stand of the Gaslight and Coke Company. In laying out the exhibit, the object to be kept in view, of course, was to provide something that would appeal to the "simple life" people; and, judging from observation, this end was attained. Only a few things were shown; but these were seen to the best advantage, against a background of oak panels. Light there was in plenty—provided by four Podmore 750-candle power lamps, and a number of "Nico" inverted burners on wall brackets, with pretty bead shades. The former lights were operated on the Telephos system, and the latter by pneumatic switches. Cooking was done, too, by a lady demonstrator; and it was just the sort of cooking to suit the visitors. That is to say, arrangements were made with the different exhibitors to cook their special food preparations for them, in which way it was made manifest to all and sundry that vegetarian dishes can be cooked by gas as well as by other means. Possibly some of the many inquirers at the stand, besides noticing how nicely the food was prepared, wondered at the tendency that is frequently displayed by "healthy food" advocates to make things appear like what they are not. This, however, is a digression, which need not be followed up.

Fitted in recesses, one at each end of the stand, were a cooker and a fire. The cooker was a Richmond, and—here is a further example of simplicity—it was provided with the Larkin "Surprise" boiler, the idea of which is to furnish sufficient water for washing-up by means of the heat of the oven while cooking is proceeding. The boiler itself is provided with a draw-off tap, and is attached to one side of the cooker; and connected with the boiler, near the top of the inside of the oven, there is a ring of plain wrought-iron pipe, right out of the way of the joint. The method of attachment is in no way complicated, and results in the appliance being held absolutely rigid. A boiler on the same principle was fitted to the Davis gas-fire, which was also shown in operation. In this case, the only visible sign of the presence of the "Surprise" boiler was the draw-off tap projecting from the side; the top of the fire itself being made into a tank. There is thus nothing whatever unsightly about the arrangement. There are many positions in which a fire so fitted should prove an advantage.

At a meeting of the London and Southern District Junior Gas Association to be held at the Westminster Technical Institute on Friday evening, Mr. Edward G. Stewart, of the Fulham works of the Gaslight and Coke Company, will read a paper on the "Technics of the Ascension-Pipe."

ELECTRICITY SUPPLY MEMORANDA.

GLANCING through the columns of our electrical contemporaries, it is observed how, week by week, there are fresh recruits from the electrical undertakings to the ranks of those adopting the method of charging by a fixed sum based on the house assessment, or on maximum consumption, with a small charge per unit for energy afterwards. Sheffield is among the latest to introduce this system. The Electricity Department is offering, as an alternative to the present tariff, a charge of 10 per cent. on the net assessment payable quarterly in advance, and ½d. per unit of energy used. All electric undertakings do not adopt 10 per cent.; others take such figures as 12½ and 15 per cent. But then all electricity undertakings have not to compete with gas at 1s. 3d., and lower prices, per 1000 cubic feet. It depends very much on the class of residents in a supply area whether or not such a scheme of charging is favourably regarded. It answers all right in districts where people are all "well-to-do;" but in other areas people are unwilling to pay lump sums of money in advance. They have not always available the necessary cash for all sorts of purposes at the beginning of a quarter; and then what is to be done if they begin to get behind with the lump payments to the electricity suppliers. The general basis for the measurement of the lump sum is rather an unfortunate one. Assessments and rates are an utter abomination in the sight of some folk; and anything that has association with assessments and rates, or that seems to partake of the character of a rate, will be shunned by them in a very resolute way. From the side of the electricity supplier, the main reason for the attachment of this form of tariff to the ordinary ones (despite the fact that it breaks down formerly idolized principles) is that one meter suffices where two are required when there is one price for lighting and another for heating and cooking; and in some cases the existing wiring will meet requirements. It is also considered that, by this system, the consumer can approximately tell what his annual consumption of current will be. We question that. If he has an electric-cooker in use, or radiators, and is left to the tender mercies and conscientious ways of Mary Jane, and sometimes of other members of a household, he must give up all idea of being able to approximately count the cost of his electric lighting, heating, and cooking for a year. If it be possible to estimate so closely, why not adopt the principle of an inclusive fixed charge at once, instead of making the charge in two parts? The Electricity Department exhibits a forced optimism on the subject of cooking and heating. A statement has been dropped into the ears of the public to the effect that it is believed, under the new tariff, that electricity will become a keen competitor with gas for cooking. A "man from Sheffield," the other day, at a meeting at which Mr. Roles' paper was discussed [this paper was noticed last week], referred to the melancholy task they had in competing with gas at 1s. 3d. and below. They hope, however, from the lump sum and the ½d. per unit to reap a great reward. But they have not in Sheffield any great faith that it will do so. Mr. Roles, it will be remembered, has not a strong belief in a large demand for electrical energy for cooking and heating where the price of gas is 3s. or under per 1000 cubic feet.

Hope Without Faith.

Cheap Electrical Heating.

But not all electricians openly endorse this view of Mr. Roles—especially those electricians with cookers and heaters for sale. Mr. C. Orme Bastian is one of these gentlemen. On a previous occasion we met Mr. Bastian in a little passage of arms, and that gentleman wound up the discussion by saying something that was not altogether complimentary, and (if we remember correctly) rather affected the question of our integrity. On that occasion, the point referred to a heat-storage box that Mr. Bastian had devised for electrical energy, and to a suggestion of ours that the system he proposed meant some amount of heat loss. Of course, we did not then know that it was a piece of presumption to oppose our views to those held by Mr. Bastian. But on this side of the way we can afford to let bygones be bygones; and we feel very friendly disposed to Mr. Bastian at the moment, because there is a little information in his possession that, by its transfer, would give us much interest, and probably something to discuss. He states, in a letter to the "Electrical Review," that he is prepared to demonstrate that heating by electricity at 1d. per unit compares very favourably indeed with heating by gas at 3s. per 1000 cubic feet, provided adequate ventilation is arranged in each case. We suggest to Mr. Bastian that he contributes an article either to the "Electrical Review," or to our own columns, explaining more particularly this success of electricity. In the interests of the electricity supply industry, he ought not to keep such information up his sleeve, for many central station engineers are unaware of how this superiority of electricity is to be demonstrated, and many consumers of electricity who have removed their radiators, and taken to the modern gas-fire on account of lower cost and greater efficiency, are painfully ignorant of what Mr. Bastian knows.

Topsy-Turvy Heating.

Bearing on this heating question, we all remember the Topsy-Turvy House of the Paris Exhibition and other subsequent shows. We are reminded of the fun of those houses by a reference made in the "Electrical Times" to a serious suggestion of

Mr. Burnand, during the discussion of Mr. Roles' paper on cooking and heating, that electric radiators should be placed somewhere near the ceiling, instead of on the floor. We hope nothing of the kind will be attempted where some of our electrical friends are concerned. Certain of them get very feverish headed at the present time, without having electric radiators communicating their heating energy direct on to their pates. We trespass on "Electrical Times" for the views of Mr. Burnand. He holds that what is required is a large volume of heat at a low temperature rather than a comparatively small heating surface running at a high temperature. Heated air, he also says, simply travels to the top of a room and stops there. Rooms are not so non-porous as that; but it is a good thing, for sanitary reasons, that it does pass upwards; and for sanitary reasons, if for no other, we prefer the heating arrangements at the bottom of the room where we move and sit, rather than at the top where the heating value of what is paid for would be largely wasted. In connection with radiant heat, Mr. Burnand holds that the articles in a room are heated at the top, and not at the bottom; and therefore the radiator should be fixed in such a position that it warmed from the top. What about the greater area presented by the vertical surfaces in a room? We shiver to think what would happen under Mr. Burnand's system. Only the tops of furniture would be heated to any extent by radiation, and then the air absorbing the heat would rise to the top of the room, without doing anything to add to the comfort below. The "Electrical Times" does not agree with the idea any more than we do. But there is still another point. A little while ago, our contemporary was telling its readers that the electric radiator gives about 30 per cent. of radiant heat, and between 60 and 70 per cent. of convected heat. Then the attention of our contemporary was called to the heat efficiency, found by scientific tests (and not conferred by guesswork), of the modern form of gas-fire—50 per cent. and upwards of radiant heat, 25 per cent. or thereabouts of convected heat, and 25 per cent. waste. Now our contemporary speaks of lamp radiators giving 75 per cent. of radiant heat, and 25 per cent. of convected and conducted heat. Who said the days of miracles had passed? Anyway, if they have, the electric radiator has shown a remarkable agility in reversing the percentages of radiant and convected heat. However, that by the way. Mr. Burnand's hot-head and cold-feet system of heating, we do not think, is destined to play a large part in our domestic life.

Society for Electrical Development.

Lately we came across an article in the "Electrical Times" headed "The Society for Electrical Development." The heading arrested attention; and we had a fancy for learning something about this Society. What followed was found to be, in the opening, one of the most peculiar literary performances that we have ever ploughed through. We read something about "adulterated philanthropy" and "honest burglary;" it was gathered that the electrical industry saw around it "a stupid and grossly ignorant people, so steeped in ignorance as not to appreciate that nowadays a civilized community lives and has its being in the complex machinery with which the engineer has so silently endowed it." In passing, came something about religion, and then an assurance that the public does not regard engineering, and especially electrical engineering, as one of the essentials of life. There were references to the Chinaman and the Jew, and to "botch and bungle." Succeeding was a re-introduction to the long-defunct Henry VIII. and Cardinal Wolsey, in whom our concern is somewhat remote. We were just getting into a somnolent condition when interest in the article was re-aroused by the assertion that what is wanted—presumably in connection with electricity supply development—is the kiss that awoke the *Belle au bois dormant*. That is the only means we are told of rousing a "grossly ignorant community to the immense possibilities that await it." Without light, heat, and power, the said grossly ignorant community would fall back into barbarism to-morrow. But it wants to hear nothing about the subject—at least, not as the news has been hitherto conveyed. "In that, the public is partly right; the thing has never yet been properly attempted." Then in a few lines, we have the practical and solid part of the article. It amounts to this, that a meeting of the Society for Electrical Development has been held in New York. The organization represents all branches of the American electricity industry—much the same as our own British Commercial Gas Association represents all branches of the British gas industry. This American Society intends, in the first place to raise £40,000, of which the first half is already at its disposal. "Its object is to demonstrate to America that the progress of civilization in any given case can roughly be measured by the extent to which electricity has been used; but the idea is to convey this lesson by a suggestive process, and through many different channels." The new American organization is looked upon as a potent factor for increasing the demand for electrical energy. All the ordinary forms of publicity are advocated; but the old ones less than the new. Publicity must march with the times; and must conform itself to current ways and interests. The cinematograph is the thing to-day; it is one of the best means of attractively getting hold of the outside public. "Convey the electrical news in an appetising form, let it be good and novel, let it serve no private ends, and it will then take its place among that 'something better.'" That is one of the best points in the article; and we appropriate it to show our gas friends that the scheme of the coming National Gas Exhibition is founded on lines that meet the strict approval of progressive electricians. The article ends by inquiring what the British electrical industry is doing to emulate the American electrical industry—a large part of which, we may add, is run in conjunction with prosperous gas undertakings.

A Reading Example.

Recently it was shown in the "Memoranda" that the accounts of some electricity supply companies showed that the farther they spread their wings, the smaller is the amount of available profit they make in proportion to the capital expended, and consequently the lower the dividend they were able to pay. The last balance-sheet of the Reading Electric Supply Company presents a case in point. In 1905, we criticized the accounts of the Company, and pointed out that the balance on the year's working only amounted to £7461, and that in their expenditure the Company had had to cut close to the knuckle in order to pay 5 per cent. dividend. Eight years later we have before us the accounts for 1912; and it is seen that the balance for distribution only amounts to £5211; and after paying a dividend of 3½ per cent., less income-tax, there is only a balance of £517 to be carried forward. The Directors have deemed it advisable to set aside £3500 out of the year's profits for the depreciation fund—making it just over £29,000. There is no reserve fund; and a very large part of the depreciation fund appears to be used in the business, and only a portion of it earning interest. Time does not deal gently with the machinery and other equipment of an electric lighting undertaking; and so good tangible depreciation and reserve funds are essentials to a sound financial condition. But the shareholders of the Reading Company who look studiously into their accounts, and consider the position seriously, will not find a strong condition of affairs. The total capital expenditure is £197,172, though the capital receipts only amount to £182,350; so that there has been an expenditure of capital of about £15,000 over and above the capital receipts. There is only £2525 of authorized share capital remaining unissued; but the borrowing powers are unlimited. For the ordinary shareholders, this position is not an enviable one. Then their dividends have fluctuated in a most uncomfortable fashion. In 1899, they were paid 3 per cent.; 1900, 4 per cent.; 1901-5, 5 per cent. But what has been the tale since our criticism appeared in 1905? In 1906-7, 4 per cent. was paid; 1908 was a blank year for dividend; in 1909, 1 per cent. was distributed; in 1910, 2½ per cent.; in 1911 and 1912, 3½ per cent. The position of the ordinary shareholder is also reflected by the value placed upon the shares in the open market. We find that in 1903 to 1905, the £5 shares were selling at about £6 5s.; quite recently, shares were sold at prices ranging from £3 10s. to £4 apiece. Not all the shares were sold, for we see an advertisement in a local paper inviting private offers to purchase. There will be an additional charge this year for debenture interest; so that the prospects for the ordinary shareholders are not happy. An analysis of the accounts discloses some interesting points. The cost of generation alone amounts to 0·62d. per unit. If we add on to this distribution 0·04d., rents, rates, &c., 0·10d., management 0·24d., debenture interest 0·13d., and depreciation 0·36d., we arrive at a total of 1·49d. Yet current for cooking purposes is being offered at ½d. per unit! Furthermore, although, compared with 1911, the cost of generation has been reduced by 0·08d. per unit to 0·62d., the average total receipts per unit have also been reduced from 2·63d. to 2·02d.—a reduction of 0·61d. per unit. On the other hand, the total expenditure on revenue account has only been reduced by 0·38d.—from 1·71d. to 1·33d. Therefore, the reduction of total expenditure falls short of the reduction of revenue by 0·23d. on every unit sold. And this 0·23d. would have been worse still had the amount allocated to depreciation been equal to 0·52d. per unit as in 1911, instead of (as it is for last year) 0·36d.

Stops and Fires.

There seems, according to the daily paper reports, to have been wonderful happenings yesterday week at the Greenwich generating-station of the London County Council, which held up the tramway traffic on the southern side for best part of the morning, to the financial gain of the motor buses. This is the third stop lately; and this time it was just as people were flocking to business. At the generating-station loud reports and clouds of steam and smoke notified outsiders that something was wrong. What was wrong is explained as follows by one of the morning papers: "The sudden stoppage of one of the engines caused a short-circuit, and the high-tension switches fused. Melted copper and boiling pitch made trouble on the floors below, where switchboards were set on fire, and one of the turbo-generators broke down. In order to extinguish the flames, the whole system was shut-down for a time." Transferring attention to Salford, it is understood the Corporation Electricity Committee have agreed to settle for £11,383 the claim against the Insurance Companies, in connection with the recent fire at the generating station.

Iron and Steel Institute.—The annual meeting of the Institute will be held at the Institution of Mechanical Engineers, Storey's Gate, Westminster, on Thursday and Friday, the 1st and 2nd prox., commencing each day at 10.30. The autumn meeting will be held at Brussels, from the 1st to the 5th of September. Further particulars of the arrangements, and of the excursions after the meeting, will be announced in due course.

THE QUALITY OF LONDON GAS.

First Quarter of 1913.

THE following is a summary, in customary form, of the results of the official testings of the gas supplied by the three Metropolitan Gas Companies during the first quarter of the present year. The corresponding figures for the first quarter of last year will be found (with references to those for previous years) in the "JOURNAL" for April 23, 1912, p. 215. The results relate in all cases to the testings made in the nineteen testing-places which are under the control of the London County Council. The period referred to as the first quarter is the thirteen weeks ended March 29, 1913.

ILLUMINATING POWER.

The average results of the testings of illuminating power are shown in Table I., for both the testings made with the No. 2 "Metropolitan" argand burner and with the prescribed flat-flame burner. The corresponding figures for the first quarter of 1911 and of 1912 are also given for comparison. By a curious coincidence, the argand value of the gas supplied by the Gaslight and Coke Company averages exactly one candle below that of the gas supplied by the South Metropolitan Gas Company. The minimum returns for the argand testings during the quarter were: For the Gaslight and Coke Company, 12·79 candles; for the South Metropolitan Gas Company, 14·07 candles; for the Commercial Gas Company, 13·81 candles. In each of the thirteen weeks of the quarter the Gaslight and Coke Company had at least one return below the prescribed illuminating power of 14 candles, and in two weeks a deficiency of not less than half-a-candle but not more than one candle was reported, and in two other weeks a deficiency exceeding one candle was observed. The Company are liable to incur a forfeiture for a single day's return if the deficiency is as much as one candle; but on any day when a deficiency of as much as one-half and less than one candle is reported, the average of the testings for that day and the preceding day and the following day is reckoned as the illuminating power for the day. If, however, that average does not represent a deficiency of as much as half-a-candle, the Company are not liable to incur a forfeiture.

TABLE I.—*Averages of All the Testings of Illuminating Power for the First Quarter of the Year* [*Candles*].

Company.	No 2 "Metropolitan" Argand.			Flat-Flame.		
	1911.	1912.	1913.	1911.	1912.	1913.
Gaslight and Coke .	14·90	14·52	14·38	8·59	8·25	8·05
South Metropolitan.	15·70	15·49	15·38	9·90	9·38	9·17
Commercial . . .	14·60	14·89	14·80	8·47	8·43	8·51

The figures given in the weekly returns issued by the London County Council are not sufficiently detailed to admit of the necessary three days' average being computed for the two weeks in which returns between 13 and 13½ candles were made. The South Metropolitan Company had no return during the quarter below 14 candles; and the Commercial Gas Company only in one week, when a minimum of 13·81 candles was found. The minimum results of the testings with the flat-flame burner were: For the Gaslight and Coke Company, 6·87 candles; for the South Metropolitan Gas Company, 7·78 candles; for the Commercial Gas Company, 7·28 candles.

CALORIFIC POWER.

The average, and maximum and minimum results of the testings of calorific power are given in Table II. The average difference of exactly one candle in illuminating power of the gas supplied by the Gaslight and Coke and the South Metropolitan Companies is attended by an average difference in calorific power of exactly 9 calories gross and exactly 8 calories net per cubic foot. No inference must, however, be drawn from these figures which does not take into account the fact that the first-named Company supplies mixed gas and the second Company coal gas only. The Gaslight and Coke Company alone of the three Companies are liable to incur forfeitures for deficiencies of calorific power—the standard being 112½ calories net per cubic foot on an average of three consecutive days' testings, and 106½ calories on a single day. It will be seen that the Company had no return during the quarter below the former figure; while the minimum return for the South Metropolitan Company was as high as 120½ calories net. The Commercial Gas Company in one week only had a return below 112½ calories net—viz., 111·6 calories.

TABLE II.—*Summary of Testings of Calorific Power (Gross and Net) for the First Quarter of the Year* [*Calories per Cubic Foot*].

Company.	Average.			Maximum.			Minimum.		
	1911.	1912.	1913.	1911.	1912.	1913.	1911.	1912.	1913.
Gaslight and Coke—									
Gross	137·5	135·3	135·3	153·4	148·6	147·6	127·8	123·7	127·5
Net	122·7	120·6	120·4	138·0	132·8	130·6	114·3	110·2	113·7
South Metropolitan—									
Gross	144·6	143·4	144·3	160·3	163·4	158·1	133·5	131·7	135·4
Net	128·9	127·7	128·4	144·5	145·8	139·9	119·0	116·6	120·5
Commercial—									
Gross	137·1	136·2	135·9	152·2	151·4	146·5	123·6	122·0	126·0
Net	122·4	122·0	121·4	135·8	136·5	131·8	110·0	112·0	111·6

SULPHUR.

The average and maximum figures for the returns of the testings for sulphur are shown in Table III. They call for no special comment, as they indicate that all three Companies have continued during the past quarter to supply gas of approximately the same degree of purity in respect of sulphur content as during the year 1912.

TABLE III.—*Summary of Testings of the Sulphur in London Gas for the First Quarter of the Year* [*Grains per 100 Cubic Feet*].

Company.	Average.			Maximum.		
	1911.	1912.	1913.	1911.	1912.	1913.
Gaslight and Coke .	34·0	34·8	36·5	62·9	63·2	55·0
South Metropolitan	26·9	24·5	24·8	57·9	55·5	47·0
Commercial . . .	28·8	27·5	26·9	61·7	47·5	49·0

SHALE PRODUCTS.*

THE translation of Dr. W. Scheithauer's book on the crude oil or tar extracted from brown coal, shale, &c., and the products obtainable from the crude oil, which is now before us, appears to be a faithful rendering into English of the German work which we had the pleasure of reviewing in September, 1911 ["JOURNAL," Vol. CXV., p. 590]. The views which we then expressed on the value of Dr. Scheithauer's treatise are borne out by a perusal of the present English version of it. Hence, we cannot do better than quote, in reference to the translation, the last remarks of our review of the original work—viz.:

> "In conclusion, we may say that Dr. Scheithauer has prepared in this volume an excellent account of the shale and brown-coal oil industries. The account is necessarily more exhaustive and authoritative in respect of the brown coal branch of the industry; but within the limits of his space, he has dealt very satisfactorily also with the Scotch shale branch of the industry."

It should be useful to English readers to have Dr. Scheithauer's work available in English; and Mr. Salter appears to have done the work of translation in a very satisfactory manner. He has exercised excellent discretion in the conversion of metric figures and German moneys into their English equivalents. He has not fallen into a common error of converting round figures of quantities produced and yields, &c., into the exact equivalent, but has given the nearest round figure corresponding with the original. Misapprehension as to the purport or bearing of the figures has thus been avoided.

It seems not unlikely that in the near future there may be a tentative revival of the industry of the production of coal oil in the United Kingdom. There is a certain amount of raw material of the brown coal and cannel classes which might well be distilled for oil-making upon much the same lines as those followed in Saxony-Thuringia. The chief ultimate products of the industry, if revived in this country, would, however, be different from the chief products of the coal oil industry of former days and the oil industry of Germany. The aim of the distillation of any suitable grades of cannel and highly bituminous coal in this country would now be the production of motor spirit and pitch, both in as large quantity and of as high a grade as possible. The many technical men, and others, who are interesting themselves more or less deeply in the exploitation of processes for the production of motor spirit and pitch as the chief commercial products of the distillation of shale, cannel, and the younger coals, may find in Dr. Scheithauer's book some useful hints as to processes and working expenses, though this quite recent aspect of the industry of oil production by distillation has, naturally, not actually been dealt with in his work, which (in German) is already more than eighteen months old.

It may be useful to add, for the guidance of our readers, that Dr. Scheithauer's work deals with tar or crude oil when it is substantially the most valuable product of the distillation process. It does not deal with the tar which is obtained as a bye-product in the manufacture of coke and illuminating gas.

* "Shale Oils and Tars and their Products." By Dr. W. Scheithauer. Translated from the German by Charles Salter. London: Scott, Greenwood, and Son; 1913.

In addition to the gold and diamond mines, the Transvaal has an almost inexhaustible coal supply, with the result that coal is marketed there as cheaply as anywhere else in the world, with the possible exception of some places in America and Japan. The output in 1911, amounting to 4,343,680 tons, was valued at £1,062,000, against 3,970,069 tons, valued at £1,027,000, for 1910. The coal industry at present employs 500 white men and about 9000 natives.

CONCILIATION IN TRADE DISPUTES.

THERE was issued some days ago the tenth report by the Board of Trade of proceedings under the Conciliation Act of 1896; the period covered being the year 1912. In presenting the report on this occasion, the Chief Industrial Commissioner (Sir George Askwith) points out that the national strike of coal miners in Great Britain in the early part of last year was terminated by the passing of the Coal Mines (Minimum Wage) Act; and it has been thought desirable to add to the report a separate appendix giving the decisions arrived at by the Joint District Boards established under the Act. The object of the Conciliation Act is to provide for the registration of such Boards as are constituted for the purpose of settling disputes between employers and workmen, and for the furnishing by them to the Board of Trade of such returns, reports of proceedings, or other documents, as may be required. Where a difference exists or is apprehended between employers and employed, the Board are also empowered to take steps with a view to an amicable settlement. Such steps may include the appointment (upon the application of either party) of a person or persons to act as conciliator or as a Board of Conciliation, or (on the application of both parties) the nomination of an arbitrator.

The year 1911 was, it will be recalled, a period of very marked industrial disturbance, and 92 cases were dealt with under the Act. Last year there was a falling off; the number of cases being 73, which, however, was higher than in any previous twelve months with the exception of 1911. These 73 cases, too, do not include appointments made in connection with the revised railway conciliation scheme. The most important disputes in which action was taken last year were the national strike of coal miners in Great Britain and the strike of transport workers in the Port of London and on the Medway. But these disastrous upheavals are still too fresh in the public mind to need further reference here, though it may be mentioned that the points in connection with them are concisely set forth in the report. Of the cases dealt with in the period covered by the report, 34 were disputes involving a stoppage of work, as against 57 in the preceding year. Since 1896, 597 cases have been dealt with; and of these there were applications from both parties in 362, or about 60 per cent. This latter figure includes a number of cases in which application for the appointment of an arbitrator or conciliator was made by the parties as the result of negotiations conducted by officers of the department. In 132 cases, or rather more than 20 per cent., application was made by the workpeople only, and in 38 cases by the employers only. In the remaining 65 cases, no application was made by the parties. It has been pointed out in previous reports that in the years immediately following the passing of the Act, application for the services of the department came mainly from one side only (generally from the workpeople); but in recent years there has been a tendency for the majority of applications to be made jointly by the parties, or by organizations representing them. In fact, during 1912 joint applications were received in 42 cases; while in 18 applications were received from the workpeople only, and in five from the employers. Of the principal groups of trades, the metal, engineering, and shipbuilding accounted for the largest number of cases. As to the carrying on of conciliation work outside the direct efforts of the department, it may be mentioned that there were in existence at the end of 1912, so far as was known to the officials, 297 voluntary conciliation boards and standing joint committees; 282 being boards dealing with particular trades, and 15 district and general boards, including both those registered under the Conciliation Act and those not so registered. Many of these boards, as well as other agreements arranged between employers and workpeople, embrace in their rules a clause providing that, in the event of failure of the parties to effect a settlement of a dispute, application shall be made to the Board of Trade for the appointment of an umpire, arbitrator, or conciliator. Such clauses, indeed, are known to exist in 103 cases.

Among the important questions dealt with in 1912 was that of the Scottish ironmoulders, which developed, after negotiations between the parties, into a matter of the date when certain advances in wages should come into operation. No agreement was arrived at on this point; and the men handed in notices to cease work. The matter was brought to the attention of the department; and as the result of a conference, a suggestion was made which was accepted by both parties, and the stoppage averted. A lock-out at a Falkirk foundry (over a question as to the production of working material, and the effect upon the wages of piece-workers), was also settled after negotiations. During the year recourse was in five cases had to the system of courts of arbitration established under the scheme of 1908; and in each instance the court was composed of three members—a chairman selected from the chairman's panel, and two arbitrators chosen respectively from the employers' panel and the labour panel. Only one of these cases involved any stoppage of work.

The members of the Industrial Council appointed in 1911 to hold office in the first instance for one year only were re-appointed for a further year; and in June the President of the Board of Trade informed the Chairman of the Council (Sir George Askwith) that the Government desired to refer to the Council certain matters which appeared to them to be difficulties in the way of peaceful and friendly relations between employers and workmen, and that they would give the most earnest attention to any recommendations the Council might be able to make. The points specially referred to the Council were the best method of securing the due fulfilment of industrial agreements, and how far (and in what manner) agreements of this character which are made between representative bodies of employers and of workmen should be enforced throughout a particular trade or district. The Council have examined a number of witnesses, and received other evidence in regard to the matter; and the inquiry is still proceeding.

TECHNICAL AND ECONOMICAL DEVELOPMENT OF THE GAS INDUSTRY IN GERMANY.

WE have received from Dr. A. Sander, of Carlsruhe, a copy of a paper on this subject which he read on Jan. 6 last before the German Association for the Promotion of Industries. The paper presents an exhaustive review of the rise and development of the gas industry, and is illustrated by a number of views of gas plant and apparatus. The way Dr. Sander has handled his theme may be gathered from the following *précis* of the paper.

The gas industry differs from other branches of chemical industry in that its technical men are free to report on, and discuss, improvements and methods of working, because gas-works do not compete one with another. This freedom of interchange of ideas has been an important factor in the advancement of the gas industry. The first German towns to be provided with a gas supply were Hanover and Berlin, in both of which gas-works were opened by the Imperial Continental Gas Association in 1826. Dresden and Frankfort-on-the-Main possessed gas-works, constructed by German engineers, by the year 1828. The number of coal-gas works in Germany is now nearly 1400, though only about 500 places have more than 10,000 inhabitants. The impetus given to gas lighting by the invention of the Welsbach mantle has reacted on manufacturing plant in the last 25 years. Modern gas-works are fully equal in respect of organization and equipment to the large works in any other branch of industry.

During recent years, the consumption of coal for gas-making has increased enormously, as a consequence of the increase in the demand for gas. The gas-works of Berlin alone now consume 800,000 tons of coal per annum. Storage accommodation for 30 to 35 per cent. of the annual consumption of coal has to be provided on gas-works, and covered coal-stores are usually erected, because many kinds of coal deteriorate if exposed to the weather. Particulars are then given of the large coal-store, 1880 feet in length, at the Tegel Gas-Works of the City of Berlin, and of coal-handling plant.* Changes in carbonizing plant are then traced from the single horizontal retort, through inclined retorts, to intermittent vertical and horizontal through retorts with charging and discharging machinery. Reference is also made to continuous vertical retorts, and to large oven carbonizers, and illustrations are given of typical installations on the Continent of various modern systems of carbonizing plant. The Koppers' chambers and the Kerpely central producers at the Leopoldau Works in Vienna are specially selected for extended notice.

Purification and the disposal and use of bye-products are dealt with, and then the application of gas for lighting and other purposes. Reference is also made to the distribution of gas by high-pressure mains to outlying districts—a system which has been greatly developed in recent years in some parts of Germany.

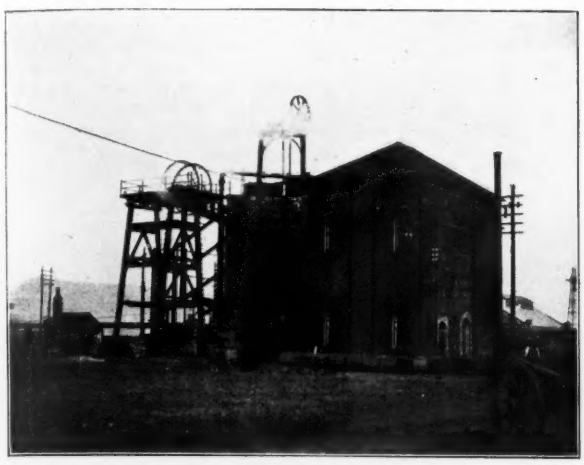
Dr. Sander then gave some statistics of the gas industry. It appears that nearly half the total population of Germany dwells in places where gas is available. In these places the average consumption of gas per head per annum is 2365 cubic feet. In many towns it is much higher—*e.g.*, Charlottenburg, 6640 cubic feet per head. But it is pointed out that these figures are below those for English towns; and Dr. Sander suggests that German gas undertakings would obtain larger sales if they were to follow more closely the business methods of private commercial enterprises. At present, the annual output of German gas-works is about 89,000 million cubic feet of gas, which at an average price of 3s. 8d. per 1000 cubic feet, brings in over £16,000,000 a year About 7½ million tons of coal are consumed in making this quantity of gas, and at 14s. per ton this coal costs about £5,000,000. The bye-products of the industry are about 3¾ million tons of coke, having a market value of about £3,000,000; some 375,000 tons of tar, value £400,000; and 15,000 tons of ammonia, value £600,000. The retort scurf and spent oxide are valued at about £50,000 per annum. The gas industry proper in Germany employs about 60,000 hands.

After the reading of the paper, a discussion ensued, opened by Dr. Wedding, Professor of Electrotechnology at the Technical College at Charlottenburg, who claimed that the electromotor was superseding the gas-engine and that electricity was displacing gas for the lighting of interiors. He was answered effectively by Professor Drehschmidt, of the Tegel Gas-Works of the Berlin Corporation, Professor Frank, of Charlottenburg, and Herr Lempelius, of the Central Gas Publicity Organization; and he received some support from Herr Wikander, who is Business Manager of the corresponding organization for electricity propaganda. The discussion was carried on with great spirit, until the Chairman brought it to a close by proposing a vote of thanks to Dr. Sander.

* An illustrated description of the plant here referred to was given in the "JOURNAL" for Aug. 4, 1908, p. 329.

THE BIRCHENWOOD COLLIERIES AND COKE-OVEN AND BYE-PRODUCTS PLANTS.

Visit of the Manchester Institution and the Junior Association.

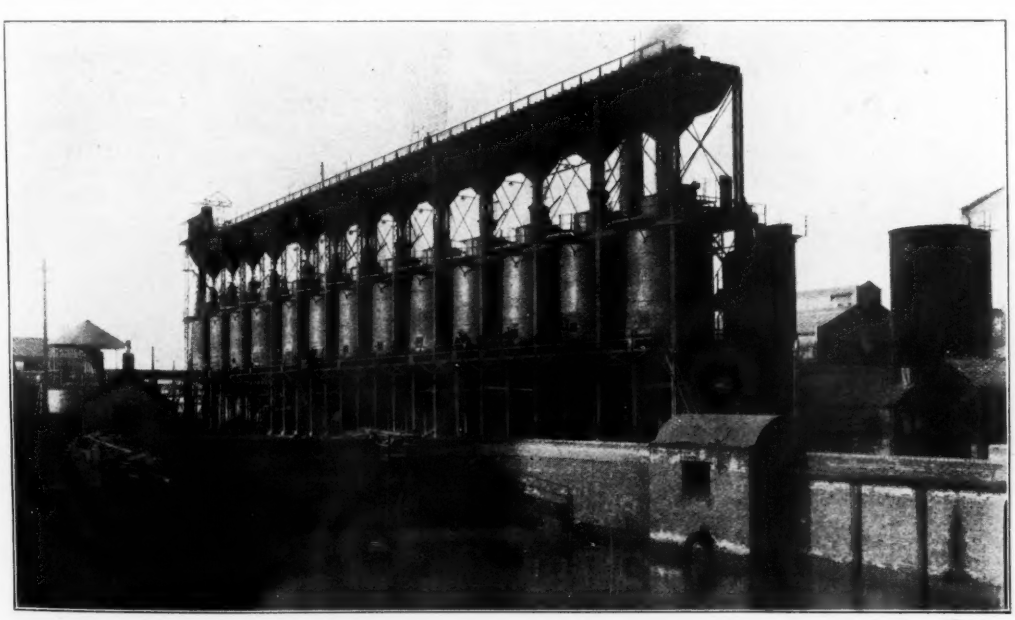


Head of No. 4 Pit.

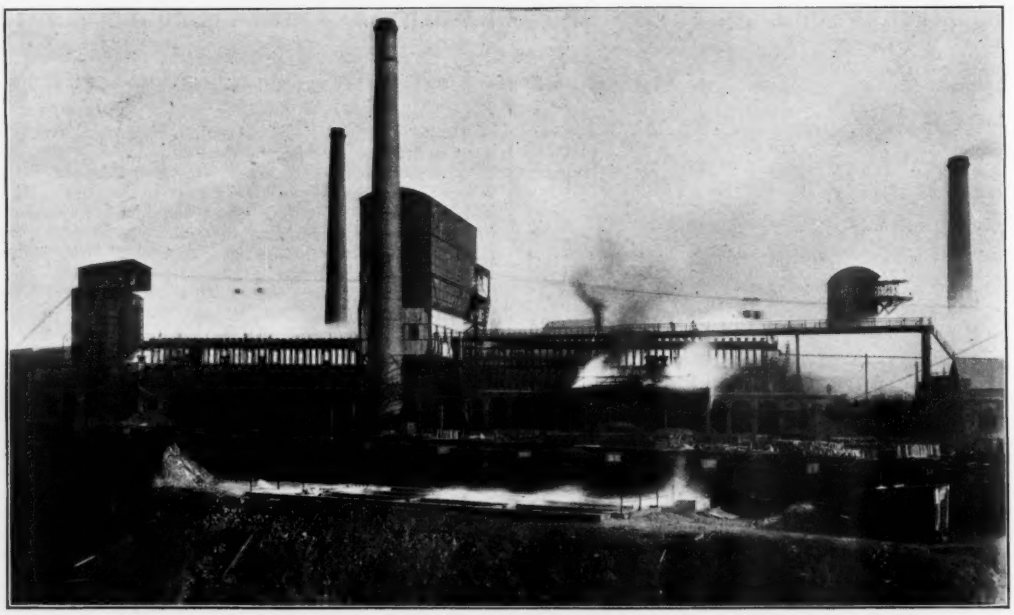
At Kidsgrove—which those geographically and industrially acquainted with the district know is situated at the northern end of the North Staffordshire coal-field—are the collieries of the Birchenwood Colliery Company, Limited. To reach these collieries one goes to Harecastle or else Kidsgrove Station (which mean almost one and the same thing), and after getting clear of a few streets bordered by small shops and dwellings, one reaches the main ascending road, at the top of which is seen the huge colliery buildings and plant, standing there as the dominating feature of the district. But one does not get any idea of the vastness of the place, and of the magnitude of the operations—engineering and chemical—which go on until one has spent at least a couple of hours in making a cursory survey. In fact, one wants to live on the place for weeks in order to get an intimate knowledge of what it all means, and of what is done. As the writer stood on a convenient eminence—to wit, on the discharging platform of one of the immense coke-oven plants—and looked round, he could not help saying to himself that Birchenwood must be to the coke-oven and bye-product recovery industry what Beckton is to the town-gas and bye-product industry. It is all so vast. There are the buildings and winding machinery connected with the coal pits; there are the extensive ranges of coke-ovens, with their spacious platforms and their ponderous machinery to deal with almost as many tons at a time as the corresponding machinery of gas-works deal with in hundredweights; there are the large buildings and plants for treating the liquid bye-products of carbonization that has for its object the production of metallurgical coke; there are the storage structures; and winding here and there are the railway lines—miles of them—just like Beckton, with their trucks, empty and laden, and countless from any one point of view. But these trucks bring in little comparatively to what they take out. The Birchenwood Colliery Company take the raw material from Mother Earth beneath the surface where the vast coke-making and bye-product recovery operations are carried on; and they set themselves to utilize a large part of it in manner that from it they send away nothing that has no value. In other words, they deal with the slack or crushed coal so as to separate to the uttermost every and any useful commodity that can be extracted from it. It is an economic proceeding; and one that has changed altogether both the aspect of the above-ground surroundings of many collieries, and the operations that are conducted thereat. This expansion of operation has introduced into mining engineering, a vaster field of engineering—both constructional and mechanical—and of heat and chemical processes. But the Birchenwood Collieries present to us something more than that to-day. The technical visitor, acquainted with the work of carbonization, and the treating of the residuals of carbonization, is shown the progress that has been made in bye-product recovery plant, and the ancillary chemical plant. The contrast is particularly seen in the latest magnificent installation of plant at these collieries, which, we opine, is one of the best and most complete to be found to-day in the British Isles.

A Cordial Reception.

It was to the Birchenwood Collieries that little batches of men on Saturday, at irregular intervals, as the trains from various parts of Lancashire, Staffordshire, and Cheshire drew into Harecastle and Kidsgrove Stations, wended their way. It was a visit that had been arranged for the members of the Manchester and District Junior Association; and the Manchester Senior Association also joined forces with the juniors, and made, when all were assembled, an excellent showing quantitatively and qualitatively, as the representatives of their hosts found when they had an opportunity of testing their capacity for, from training and experience, technically investigating the processes conducted there. It was in the Rescue and Ambulance Room at the main entrance that the visitors were received by Mr. James R. L. Allott, the Agent and General Manager of the Birchenwood Colliery Company, and his technical staff. One is quickly at home with Mr. Allott. His friendly handshake, his cheery word, the perception that one soon gets of the thorough master of works and processes from their *alpha* to their *omega*, as well as of the friendly relations that exist between chief and staff, and the interest that at the very outset he evinced in the visit, together with his personal assistance to the visitors, helped materially to make the whole visit one of great pleasure and instruction. There was freedom about it all, and none of the stiff procedure that makes some visits to works tiring before much advance has been made. In a few words, Mr. Allott introduced to the visitors those who were to be chiefly responsible for conducting them round the place and plant. There was Mr. J. West, the Manager of the Simon-Carvès coking and bye-product plant, and Mr. D. V. Hollingworth, F.C.S., the Manager of the "Carl Still" coking and bye-product plant. There was also Mr. Norman MacGowan, the Manager of



A VIEW OF THE MOND GAS-PRODUCERS.

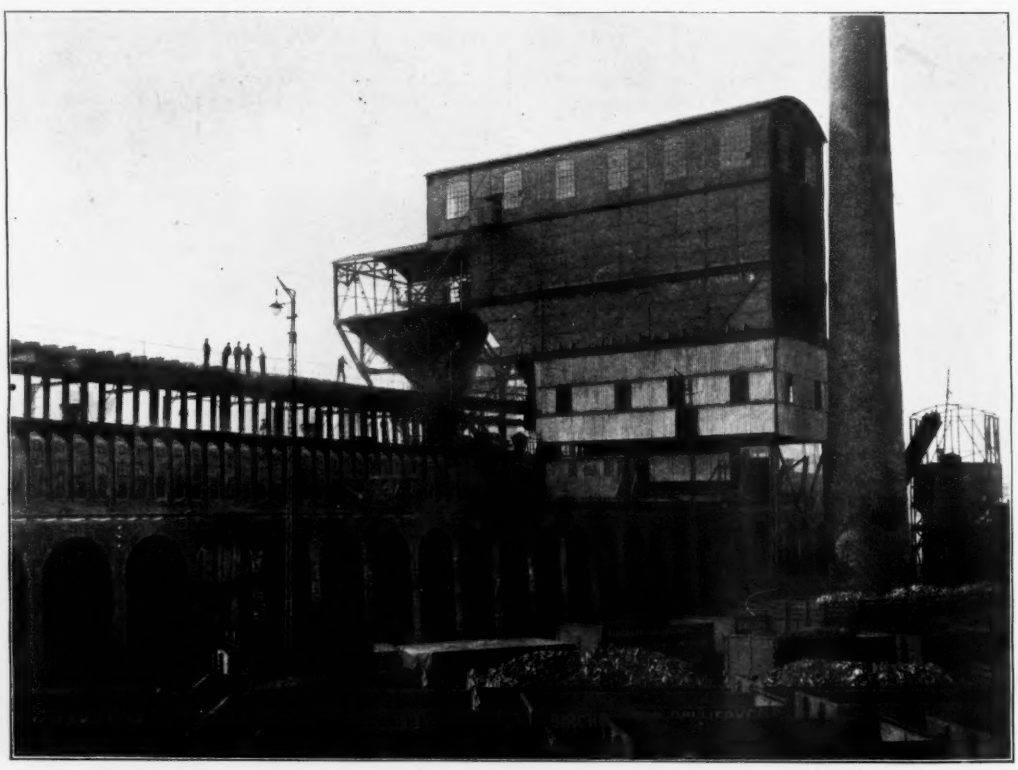


FRONT VIEW OF THE "CARL STILL" COKE-OVENS.

the pit, and his brother Mr. Reginald MacGowan, the Manager of the Grange Colliery. To the regret of the visitors, Mr. F. J. Mason, the Secretary of the Company, was unavoidably prevented rom being present. It was largely due to Mr. Hollingworth that this visit was arranged—in fact, the official position occupied at the colliery and his presidency of the Manchester Juniors last year were jointly the *raison d'être* for the visit. It is customary for the Junior Association to visit during his year of office the works where their President is located; but Mr. Hollingworth's year of office ended a few weeks ago, with custom still unfulfilled. This was unfortunate, but unavoidable; but full recompense was found, as soon as it was possible for the visit to take place. And, as already shown, it was as great a pleasure to the chief and the colleagues of Mr. Hollingworth, as to that gentleman himself, to see such an excellent muster of his friends of the gas industry, and one or two outside the industry. *Prior tempore, prior jure;* the seniors must this time give way to the juniors. Therefore we first mention that among those present were Mr. W. L. Heald, of Preston, the President of the Manchester Junior Association, and Mr. James Bridge, of Stretford, the Hon. Secretary. In the second place, the President of the Senior Manchester Institution (Mr. J. C. Belton, of Chester) was there; and the late President (Mr. S. Glover, of St. Helens). Only their names are mentioned in virtue of their official positions, as it would make a long list to register those of all the visitors. The members of both the junior and senior bodies were there as one party on exploration intent. An interested visitor outside the gas profession, but the member of a profession to whom many works are indebted, was Mr. H. Curbushley, the Chief Engineer to the North Staffordshire Canals.

The Inspection.

It is a difficult thing to describe, in such a vast creation as this at the Birchenwood Collieries, all that one saw in going over only part of the place; and it is still more difficult—in fact, impossible—to describe what, for want of time and opportunity, one did not see. Some of the party went to one or other of the scenes of activity; the bulk of them devoted themselves to the coke-ovens and the bye-products plants. All started together, by inspecting the fitting up of the Rescue Apparatus and Ambulance Room, which contains six full sets of Fleuss "Proto" rescue apparatus; also an oxygen cylinder charging-pump, smoke helmets, reviving apparatus, &c. In this room, there is a place for everything, and everything is in its place—ready for the emergencies, which, it is



ANOTHER VIEW OF THE "STILL" COKE-OVENS AND BUNKERS.

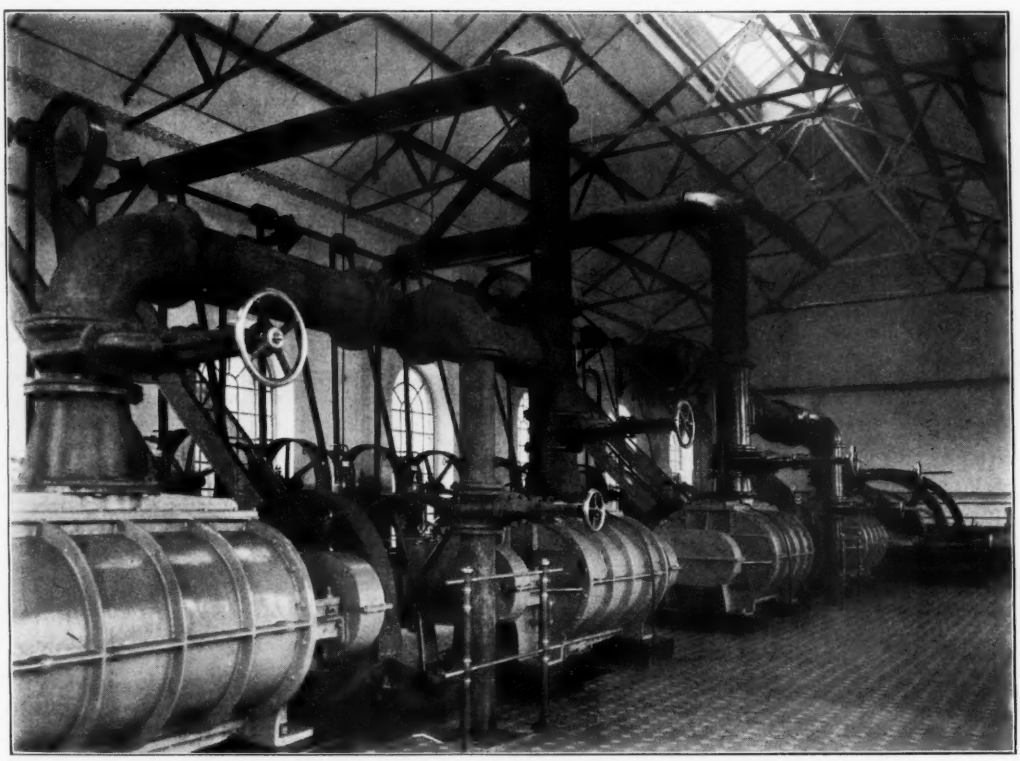
hoped, will never come. But the Company and Mr. Allott believe in preparedness; and there is systematic training for those who may be called upon to render aid to comrades and to face danger. There is also an Oldham gas-testing apparatus used for demonstrating to the underground officials the size of the gas caps on the safety lamp flame in known percentages of gas. Outside in the large open space, before reaching the buildings at the head of the first pit (which space is kept spick and span), it was observed that arrangements were in progress for the erection of masts to assist in giving Their Majesties the King and Queen a loyal and warm welcome when they visit the colliery and works to-morrow, to witness the processes by which coal is made to yield such a rich diversity of products—all useful and valuable, some beautifully coloured, some otherwise. The visitors came to one of the pit-heads; and here some of the more intrepid of them, who preferred to see the underground workings while opportunity offered, rather than the overground plants, prepared themselves for going down in company with the Manager of the pits (Mr. Norman MacGowan).

The Collieries.

While these preparations are being made, a glance is taken at the notes provided for guidance. From these it was learned that there are five shafts in use; the principal one being No. 18. This was widened and sunk down to its present depth of 430 yards to the Silver Mine seam in 1889. The Silver Mine lies about 40 yards below the Winpenny coal. The latter is the lowest worked at this colliery. The seams worked are in the lower coal series, and lie at a high inclination, varying from 30° to 70°, necessitating in various parts of the workings the use of cage dips. Nine seams of coal are at present being worked, varying in thickness from 3 feet to 8 ft. 6 in.; the system of working generally adopted being "heading and drifting." Other shafts in use are the No. 4 for pumping and ventilation as a downcast, No. 6 for ventilation is an upcast, and Kidswood, near Harecastle Station, which is also an upcast. The underground haulages along the main crut and in the West Winpenny slant are operated electrically; other haulages inbye are operated by compressed air engines—the main and tail system being largely adopted. The ventilation is produced by means of two Waddle fans, each 25 feet in diameter. Two new fans are also being put down of the Bumsted and Chandler type, with arrangements for reversing the air. The air-compressing plant consists of three horizontal two-stage sets (by Messrs. Walker Bros., of Wigan), capable of compressing 8500 cubic feet of free air per minute to a pressure of 70 lbs. per square inch, at a speed of 50 revolutions per minute.

New screening plant is being erected at No. 18 pit by Messrs. Nortons (Tividale), Limited, for dealing with an output of 1500 tons in eight hours, consisting of three mechanically driven tipplers, three shaking screens, and four picking-tables. Arrangements have been made at the end of the picking-tables so that the coal can either be loaded into trucks or conveyed direct into crushing plant for the coke-ovens.

The steel headgear at No. 18 pit, which is 93 feet high to the centre of the pulleys, has been erected within the past twelve months, together with the Heapstead and simultaneous decking arrangements by Messrs. Naylor Bros., Golborne, Lancs.



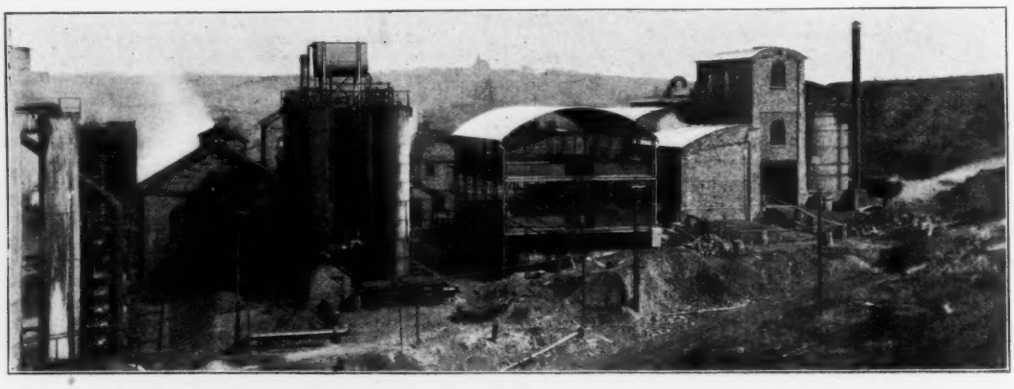
INTERIOR OF THE "STILL" PLANT EXHAUSTER HOUSE.

The washery is of the Luhrig type, capable of dealing with 1000 tons of slack in ten hours. It is arranged in two separate units of 500 tons, each of which can be operated independently. The fine slack for the coke-ovens is drained on a "Baum" draining band; and the clarification of the water is effected by circulating it over a large conical tower erected over the draining-band by means of a turbine pump. A 120-horse power motor operates the draining and clarifying apparatus.

Steam is produced by 29 Lancashire boilers, 30 feet long by 8 feet diameter in four batteries, three of which are fitted with Green's economizers. The working pressure is 90 to 100 lbs. per square inch. Eight of the boilers are fired by waste heat from the coke-ovens, six are fired by coke-oven gas, and the remainder by producer gas. The workshops comprise fitting, smiths', and carpenters' shops.

The Gas-Producer Plant.

Those visitors who were not descending the pit made an inspection of the winding plant; and then, in another building, of the pumping plant, where there is a veteran in the way of a pump for keeping the underground workings clear of water, which is somewhat considerable. Mr. Allott, mentioning that one generally spoke of such plant in the feminine gender, pointed to the misnomer on the face of this pump. Prominently stamped on it is the name "Goliath." Mr. Allott told the visitors that this is a veteran; and it is the twin of another similar piece of plant, which enjoys life under the appellation of "David." These twins, it seems, can claim to be something like centenarians; having been born in Glasgow about a hundred years ago. They have had a roving existence; "Goliath," for instance, having, after a length of useful work in Scotland, travelled to Wales and laboured there for a period, and then in due time found service at the Birchenwood Colliery. From this point, some of the visitors were taken by Mr. Allott to see the gas-producer plant; while others were taken by Mr. West to see the coke-oven and bye-products plant that is under his care. The party who accompanied Mr. Allott saw (as one of the photographs shows) a fine range of thirteen Mond producers, which were erected in 1900 by the Power Gas Corporation, to provide gas for boiler firing, and for driving gas-engines to generate electricity for general power purposes. Of the thirteen producers, eleven are of the dry bottom type, fitted with a mechanical arrangement for the removal of ashes, while the remaining two are of the standard water-bottom type. The fuel is elevated into overhead bunkers, capable of holding 320 tons; and each producer is equal to gasifying 20 tons of fuel per twenty-four hours, or a total for the plant of 260 tons. The ashes are removed from the dry-bottom producers by an electrically operated ash-waggon running on a track beneath the producers. The blast is provided by two Roots type blowers, driven by single cylinder vertical engines (by Samuelson, of Banbury), capable of delivering 10,000 cubic feet of air per minute against a water gauge of 28 inches. The air on its way to the



VIEW OF THE TAR DISTILLERY PLANT.

producers is saturated in a horizontal hot-water vessel, fitted with revolving dashers, electrically operated, and further by exhaust steam, collected from the colliery winding engines and washery. Before entering the producers, the saturated blast is superheated by the heat from the gases leaving the producers.

The gas passes into a large main and dust arrester, and then into a horizontal type washer fitted with electrically-driven dashers, which fill the vessel with water spray, and which free the gas from the bulk of the dust. It then passes through a vertical spray arrester into an ammonia absorber. This vessel is of similar design to the first washer, and contains a weak solution of sulphuric acid. On leaving this vessel the gas travels through another vertical spray arrester into a third horizontal washer, and thence into two vertical cooling towers, which reduce it to atmospheric temperature. It then passes into a large main, which supplies the boilers and gas-engines. The gas for the engines is further cleansed by passing through centrifugal washers and sawdust scrubbers.

The tar recovered from this plant is distilled in a specially designed vacuum still; the products obtained being pitch and a little creosote oil. The acid liquor from the absorber is conveyed into large storage tanks in the base of the sulphate factory. It is here evaporated in an apparatus of the Campbell and M'Lean type; and the sulphate of ammonia is finally dried in an electrically-driven centrifugal machine by Messrs. Watson, Laidlaw, and Co., of Glasgow.

The Gas-Driven Electricity Generating Plant.

Speaking of gas-engines and the generation of electricity, we may as well at once describe the plant, which is of an extensive order; and it illustrates well how gas and electricity combined may be usefully employed where scattered power is required for several purposes about a spacious works such as these. The electrical supply consists of three-phase alternating current, generated at 2500 volts, 60 cycles, and is conveyed to various sub-stations on the colliery by means of overhead bare copper transmission lines, and also by overhead three-core solid bitumen insulated cables—the general practice being to have as few cables in the ground as possible. Each sub-station contains stepdown transformers for reducing the pressure to 500 volts for the supply of small motor circuits; the larger units taking current direct from the 2500-volt bus-bars.

There are two generating stations. The older one contains three Bellis and Morcom-Mather and Platt high-speed sets of 300 KW. capacity. There is also installed in this station a 75 KW. Westinghouse rotary converter, for supplying direct current at 200 volts for the colliery lighting. The new power station contains three horizontal Körting two-cycle gas-engines, driving alternators of 300 KW. capacity; the combined sets being by Messrs. Mather and Platt. An extension of this power station is in progress; and when completed will accommodate three 1000-KW. alternators, coupled direct to vertical "Duplex" gas-engines, one set of which is now under construction at Messrs. Mather and Platt's works.

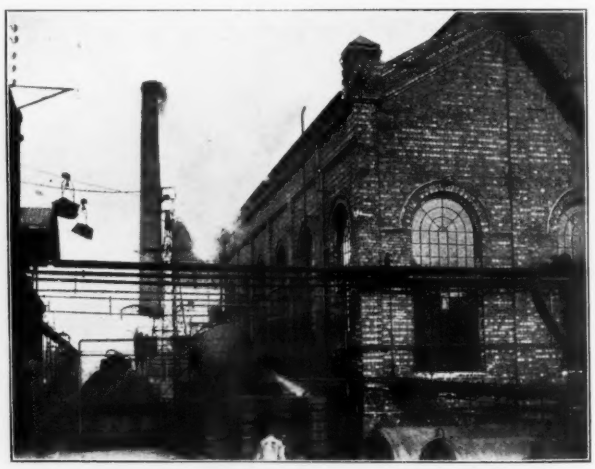
An overhead transmission line from the east-end of the new power house transmits alternating current, at a pressure of 12,000 volts, to the collieries of Messrs. Robert Heath and Sons in the Biddulph Valley, and has a capacity of 1000-horse power. The stepup transformers are contained in a house at the foot of the terminal poles.

As already intimated, electrical driving is used extensively on the colliery, both above and below ground—nearly 100 motors being coupled up to the mains. Included among these are two large pumping units, each consisting of a 750-horse power motor coupled to a Mather and Platt turbine pump, capable of delivering 1800 gallons per minute against 950 feet head when running at 900 revolutions per minute.

The Simon-Carvès Coke-Oven and Bye-Product Plant.

It has been previously mentioned that there are two coking and bye-product plants. The first one embraces 84 ovens of the Simon-Carvès type, and the second (this is of later construction) is known as the "Still" type. The former, as said, is under the management of Mr. West; and the more modern one under that of Mr. Hollingworth. It was Mr. West that the largest of the parties was first called upon to follow. In passing along, much was seen of the complete transport arrangements with which the works are equipped, much of the coal plant, much of the residuals storage plant, and, in short, much else that cannot be described in detail in a single article. Briefly stated, the plant under Mr. West's care (which was erected by Messrs. Simon-Carvès, Limited, in 1909) consists of 84 ovens, 60 of which are of the non-regenerative, or waste-heat, type, and 24 of the regenerative type, with complete bye-product plant for the extraction of tar, ammonia, and 65 per cent. crude benzol, as well as a distillery for the working up of the tar. Each oven takes a stamped charge of 8 tons of slack, and yields about 5½ tons of dry coke. The size of each oven is 32 feet long, 6 ft. 6 in. high, 19½ inches wide at the charging end, and 20½ inches wide at the discharging end.

The slack is transported from the washer to the ovens by means of an aerial ropeway (by Ropeways, Limited), capable of conveying 50 tons per hour. Storage bunkers are provided at opposite ends of the batteries, of 500 and 600 tons capacity respectively. The slack-stamping and coke-discharging machine is self-contained and in duplicate; Messrs. Buchanan and Son, of Liverpool, being the makers. The machines are electrically operated; a 35-horse power motor being used for the charging, and a 10-horse power one for the stampers.



Exterior of Benzol House.

The visitors watched with interest the work of discharging and charging the ovens. Those who had never seen a solid wall of incandescent coke, practically of the dimensions already cited for the ovens, were interested beyond measure. In the case of the 60 non-regenerative ovens, they witnessed the coke discharged on to a sloping bench paved with cast-iron plates, and passed through a "Darby" quencher hood, to which water is supplied at a pressure of 80 lbs. per square inch. In the case of the twenty-four regenerative ovens, they saw the coke discharged into a Goodall quenching, screening and loading machine, which, briefly described, consists of a quencher hood and a large cast-iron table rotating clockwise, and driven by an electric motor of 22-horse power, so arranged as to make two complete revolutions during the discharge of the oven. The coke, after quenching, is allowed to remain upon the table of the machine in order to allow its own heat to drive off as much as possible of the moisture introduced during the process of quenching. It is then loaded into truck by rotating the table in the opposite direction, and at the same time opening a large ploughshare gate, which directs the coke over a shaking-screen into a truck. The breeze, which is thus separated from the coke, is collected into a box below, and loaded into a separate truck.

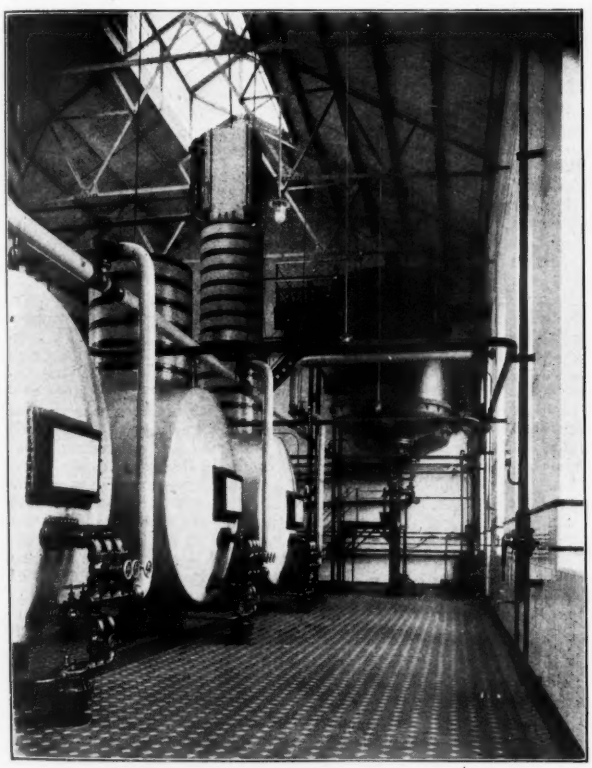
The visitors passed through the narrow galleries below the ovens to inspect as far as possible, the heating arrangements. They found the temperatures in the narrow passages somewhat high.

However, it was learned that the ovens are heated by a series of thirty vertical flues. In the non-regenerative type, the burning gases ascend fourteen flues on either side of the centre of the oven, and descend into the waste-heat flue by two down-takes in the centre of the oven. In the regenerative type, the burning gases are carried up fifteen vertical flues on one side, and descend fifteen vertical flues on the opposite side into the regenerators. Two regenerators are filled with chequer-brick work, for extracting the heat from the waste gases. These are alternately brought into use for periods of thirty minutes, by a suitable arrangement for closing valves on the gas-main and simultaneously operating the dampers.

Accidents will happen in the best of regulated plants; and so three lines of tramways are laid upon the tops of the ovens, and three charging-holes are provided over each oven, for top charging in case of a breakdown of the stamping-machine.

The volatile products are conducted from each oven by means of an ascension-pipe, which is connected to a large U-shaped "hydromain" [this is a very useful contraction], through which a stream of tar is constantly flowing.

The three exhausters in use with this plant are by the Bryan Donkin Company, Limited, of Chesterfield. They are operated by means of vertical single-cylinder steam-engines, working at a steam pressure of 70 lbs. per square inch. The gases are drawn through vertical annular and horizontal serpentine coolers, where the temperature is reduced from about 240° to 25° C., thus depositing the bulk of the tar, which is piped into a deposit tank below



Part of the Interior of the Benzol House.

the level of the coolers. After passing the exhausters, the gas is forced through tar-extractors of the Pelouze and Audouin type, which, we were told, satisfactorily removes all the tar fog. From these the gas passes through five vertical scrubbers for the extraction of ammonia, and three vertical scrubbers for the extraction of benzol. From the last of these, the gas is piped back to the ovens for heating purposes, and the surplus is used at the tar-distillation plant and for steam raising. The liquor from the ammonia scrubbers is collected in a large low-level tank, whence it is pumped to a high-level tank on top of the exhauster-house, and thence into the stills of the ammonia-house, where a concentrated ammonia liquor is made in a Brunner Mond absorbing plant. The strength of the liquor varies from 15 to 17 per cent. of ammonia. The rich oil from the benzol scrubbers is also collected in a low-level tank, from which it is pumped through a still in another building for the manufacture of 65 per cent. crude benzol. The tar from both plants (Simon-Carvès and Still) is treated in a distillery situated behind the Simon-Carvès bye-product plant. A certain amount of muriate of ammonia is obtained from some of the pitchy residues of the tar.

The "Carl Still" Coking and Bye-Product Plant.

It may be imagined, from this sketch of the plant that was inspected, that some time was absorbed in and about it. The mere description, however, fails to give any adequate impression of the dimensions of the plant in its every part. At this point the visitors came under the charge of Mr. Hollingworth, who has the newer of the plants under his care. He, like Mr. West, is enthusiastic over his plant; and he knows it and the associated processes with the intimacy that comes from a close study and watchfulness of all parts. It is a magnificent plant. It was only brought into use in October last year; its newness is obvious, and so are certain structural improvements. There are 72 of the Still coke-ovens of the regenerative type; and they are erected in two batteries of 36 each. In regard to the working-up of the bye-products, we have something here far more extensive than is the case with the older plant. In addition to a complete bye-product plant for the extraction of tar, ammonia, and 65 per cent. crude benzol, there are plants for the rectification of the benzol, and for the manufacture of carbolic and cresylic acids and pyridene.

Turning first to the ovens, there are several interesting points about them and their working, which Mr. Hollingworth explained as the visitors passed along. As in the case of the other plant, so in this, the charging and discharging operations were witnessed; and the galleries below the ovens were also visited for the inspection of the heating arrangements. There is a little more space found in these; and the temperatures that greet the visitor are not quite so high as formerly experienced. The charges are larger in these ovens; and at present their duration is 34 hours; but there is hope of reducing this period to 30 hours. The stamped charge takes 9½ tons of slack, and yields about 6·6 tons of coke—each oven being 33 ft. 6 in. long, 7 ft. high, 19¾ in. wide at the charging end, and 21½ in. wide at the discharging end. The supply of slack is from a bunker midway between the two batteries. This bunker has a capacity of 1100 tons, and is supplied with slack from an aerial ropeway by Messrs. Bleichert, Limited, capable of conveying 70 tons per hour. The arrangement of this is interesting, inasmuch as the slack is discharged from the buckets while in motion into a primary bunker, from which the slack is elevated on to a horizontal conveyor above the main bunker. The bunker, elevator, and scraper conveyor are operated by a 45-horse power electric motor.

The charging and coke-discharging machines (by Messrs. Hardtmann and Co., of Zsecks) are electrically operated by a 45-horse power motor. The machines are singular in that a block is provided which ensures free space between the end of the cake and the oven-door; this being designed to obviate black ends of coke, and to avoid the strain of withdrawing the peel against the oven-door. The coke is discharged into two Goodall quenching, screening, and loading machines similar to the one described when dealing with the older plant. Three lines of tram are laid upon the tops of the ovens; and three charging holes over each oven are provided for use in case of necessity.

Regarding the heating of the ovens, this is accomplished by a series of thirty vertical flues. The burning gases pass up fifteen flues on the one side, and down fifteen flues on the opposite side into the regenerators; the course of these gases being altered every thirty minutes. The gases for heating enter at the base of the flues; and the preheated air for its combustion is admitted at two points in each flue—one at the bottom of the flue, and the other some distance above. This is designed to obviate a cutting heat at the base of the oven, and to produce a more even disposition of the heat over the oven walls. Mr. Hollingworth fully explained this.

An innovation is also brought to notice in connection with the oven fittings. The volatile products are conducted from each oven by means of an ascension-pipe connected to two U-shaped "hydromains" for lighting and heating gas respectively—this being the first installation in this country so arranged. From the "hydromains," the gases pass through two foul mains situated on each side of the "hydromains," and thence through six tubular open-topped water-coolers for the extraction of tar. Each of the coolers is divided into four sections. The flow of the water is effected by means of an electrically-driven turbine pump, which maintains it in continuous circulation through the gas coolers and over an open-type cooling-tower.

Concerning the exhausters, there are four of the Connesville type, arranged in pairs—two for the lighting-gas section, and two for the heating-gas section. These, together with the pumps, are operated by means of a 60-horse power Körting two-cycle gas-engine; a steam-engine being provided as a stand-by. Vertical single-acting pumps are used for circulating the ammoniacal liquor and creosote oil for the extraction of ammonia and benzol from the gases, as well as for lifting tar to the "hydromains."

Of the ten scrubbers forming part of the plant, six are for the extraction of ammonia, and four for benzol. The tar from the coolers and the liquor from the scrubbers pass into two underground tanks, each of 35,000 gallons capacity. From these tanks the ammoniacal liquor is lifted into an overhead tank, whence it flows by gravity to the sulphate of ammonia stills, and the tar is pumped to the distillation plant previously referred to.

Storage tanks are provided in the basement of the exhauster-house for the benzolated creosote and raw creosote. The former is pumped through the heaters and still in the benzol rectification house for the manufacture of 65 per cent. crude benzol. This, together with the crude benzol from the Simon Carvès plant is worked up into 100 per cent. benzol, 90 per cent. benzol, toluol, xylol, and solvent and heavy naphthas. The creosote residue from the rectification of crude benzol is worked up into whizzed naphthalene and clear creosote in a separate building. The waste acid from the benzol rectification plant is regenerated in a series of acid-proof pans; the regenerated acid being afterwards used in the sulphate of ammonia or the pyridene plant. The benzol

rectification house is a splendid building, with very attractive interior, as the photographic reproduction shows. The visitors saw that Mr. Hollingworth had prepared a very interesting exhibit for the King and Queen to inspect to-morrow. This consists of a very complete collection of products obtained from coal tar, liquor, &c. The specimens are all proportional, beginning with 5 cwt. of slack, and ending with a few grains of saccharin, heliotiopine, coumarin, &c. Before leaving the house, Mr. Hollingworth took occasion to draw attention to this exhibit of products obtained from coal.

Mr. Hollingworth said the exhibit was arranged to illustrate the quantity and kind of substances obtained from 5 cwt. of coal, and embraced more than a hundred specimens, representing not only tar, liquor, and benzol, but also medicines, photographic materials, essential oils and perfumes, colours and dyes, disinfectants, &c. Having dealt with the primary products from the coal (coke, tar, ammoniacal liquor, and crude benzol), he showed the main products from the tar—viz., light oil, middle oil, creosote oil, anthracene oil, and pitch. He then described how from the middle oil were obtained carbolic and cresylic acids, pyridene, naphthalene, and clear creosote. This was followed by a description of the processes employed to produce pure carbolic acid, picric acid, and explosives therefrom, cresylic acid, and sheep dips and disinfectants. He also showed examples of perfumes obtained from carbolic acid—such as coumarin and vanillin, examples of medicines such as salicinet, and photographic materials, such as pyrogallic acid, amidol, &c., as well as dyes, such as eosin and fluorescein. Examples of products from anthracene oil were next exhibited and described, including pure anthracene, anthraquinone, and alizarin. A beautiful series of colours obtained from the latter were exhibited, consisting of turkey reds and alizarin orange. When dealing with the products from naphthalene, the lecturer described how many valuable substances were prepared, and mentioned the naphthols as being the starting-point of many famous dyes, such as magdala red, Manchester yellow, &c. He also showed how lampblack, firelighters, &c., were made from naphthalene. The products from the crude benzol were then described. Mr. Hollingworth showed the quantities of 90's benzol, toluol, xylol, and light and heavy solvent naphtha obtained from the block of slack exhibited. He mentioned that at Birchenwood the plant for the rectification of the above spirits was of most modern construction, and capable of producing benzol of such purity that 100 per cent. would distil over while the thermometer registered an increase of only 0·5° C. He compared this with the behaviour of 90's benzol during the distillation of which the temperature range would be 30° C. A remarkably beautiful series of aniline dyes was exhibited showing their formation from benzol by way of nitro-benzol and aniline. This comprised blues, malachite greens, majentas, and other methyl dyes. The production of saccharin and artificial musk from toluol was described, and samples shown. Medicines such as antipyrine, antifebrine, phenacetin, &c., were also included in the collection, as well as many examples of photographic developers, perfumes, &c. Before concluding, Mr. Hollingworth exhibited a sample of Birchenwood non-freezing motor spirit, in which the Company are doing a very large business. At the close, a few facts were given showing that nearly 1½ million gallons of crude benzol per annum were worked up in the benzol plant, and more than the equivalent of 5000 tons of sulphate of ammonia in the combined plants.

Proceeding with the general description, storage is provided for over 100,000 gallons of benzol products by twelve large storage boilers, 30 feet long by 8 feet diameter. The purified products may be loaded either direct into railway tank-waggons holding 10 tons, or into drums of various sizes. For convenience in loading these drums into trucks, suitable cranes have been installed. The ammoniacal liquor is worked up into sulphate of ammonia in the usual way; the plant being arranged in duplicate—each set consisting of a free ammonia still and fixed ammonia still. The saturators are totally enclosed, of the self-ejector type. The sulphate is whizzed to free it from moisture; the whizzers being of 4 cwt. capacity. The sulphate-store is of large dimensions, and capable of holding about 200 tons of sulphate. The middle oil from the tar-distillation plant is worked up into carbolic and cresylic acids and pyridene. The apparatus consists of the necessary agitators for washing, absorbers, and still.

The visitors derived a large amount of interest and instruction from all that Mr. Hollingworth had to show and to tell them; and this brought them to the end of their inspection.

A Brick-Making Plant.

An additional piece of information may be included to make complete this outline of the Birchenwood Colliery Company's operations. This concerns a brick-making plant, which is situated at the east side of the colliery, and consists of a Bradley and Craven brick-press (capable of producing 10,000 bricks per day), and a Hoffman continuous kiln, which will burn 70,000 bricks per week. The material used is obtained from a marl hole situated near by.

A Tea and Hearty Thanks.

After the inspection of the works, the visitors, numbering about 50, were, by invitation of their hosts, entertained at tea at the Harecastle Hotel. Afterwards,

Mr. W. L. Heald (Preston), the President of the Manchester Junior Association, proposed that a hearty vote of thanks be given to Colonel Heath, the Chairman of the Birchenwood Collieries, Limited, to Mr. J. R. L. Allott, General Manager, and to Messrs. D. V. Hollingworth, F.C.S., J. West, Norman MacGowan, Reginald MacGowan, and C. M'Guire, for the enjoyable and instructive visit that afternoon. It had, he remarked, been the privilege of the visitors to see coking plant on a very large scale—in fact, too large for them to fully understand all they had seen. The members had been very interested in seeing the plant which was under the charge of Mr. Hollingworth, who, they all knew, was one of the members of the Association, and last year's President. The Association were very proud that their late President was in charge of such a huge undertaking as the "Still" plant. He wished him every success, and was sure he would have many opportunities of advancement in the future. The exhibition of the specimens of bye-products obtained from the destructive distillation of coal, prepared by Mr. Hollingworth had been of much interest to the members. It had been a pleasure to him (Mr. Heald) to meet the gentlemen in charge of the works at Birchenwood; and he would like to welcome such gentlemen into their Association. He considered the visit was one of the finest they had ever had; and he knew that the members were sincerely grateful for the opportunities they had had that afternoon. The meeting between coke-oven managers and gas engineers would, he hoped, be a means of drawing closer the two industries. He thought both would be considerably benefited by the inclusion of such men in the Gas Associations; and they would welcome them.

Mr. Samuel Glover (St. Helens) seconded the proposal, in the absence of Mr. Belton, the President of the Senior Institution (who had to leave by an early train). Mr. Glover said the one thing that had struck him from the very beginning of the proceedings was that it was quite evident that the visitors were meant to see and know all that was possible. It was no mere superficial visit of inspection; but a real educational treat. Therefore, he most heartily seconded the proposal that their best thanks be given to the Birchenwood Colliery Company and to the General Manager and staff who had treated them so liberally. It was a surprise to him, although he had been led to expect to see a very large works, to see such a vast undertaking; and he was sure that all the members, senior and junior alike, would carry away some information which would be of the greatest service to them. Mr. Glover said that he had been acquainted with coking plants for very many years; but he had never seen a plant of such dimensions and built on such modern lines as he had inspected that afternoon. He was particularly impressed with the apparatus provided for dealing with accidents, and was much interested in the various new safety lamps and lamp-testing appliances which had been so kindly shown to them by Mr. M'Guire. He was very pleased that this first joint visit between the Junior and Senior Associations had been so successful.

Mr. Allott, who was received with much applause, said he was afraid he would have some difficulty in finding words to suitably acknowledge the very hearty vote of thanks—first of all, to the Birchenwood Colliery Company for allowing the members of the Manchester Junior Gas Association, also the members of the Senior Institution (who, he understood, had joined the juniors on this occasion) to see the works, and, secondly, to the officials for taking the members round the works. The Chairman (Colonel Heath) and Mr. Mason, the Secretary, would have liked to have been present, but were unavoidably prevented from doing so. However, he trusted that everyone had had an interesting and useful afternoon. He thought the visitors would agree that it had been a remarkable achievement to carry out these large extensions in the short space of four-and-a-half years. The plants contained many points of interest; and he was sure it had been a great pleasure to the Company to allow those present to inspect them. The short time at their disposal, however, had been altogether insufficient to enable them to obtain any real conception of the extent of the place. The colliery, although an old one, had many points of interest, and would, he felt sure, compare favourably with any of the large modern collieries when the equipment which the Company were installing was completed. The visitors would be interested to know that the whole of the coal raised—nearly 7000 tons per week—was used on the two coking plants that had been inspected. The President had hinted at the possibility of coking and bye-product plant managers becoming members of the Association. This, he (Mr. Allott) felt sure, would be a step in the right direction, and would not only be an advantage to the Association, but would be to the mutual advantage of everyone connected with the coking and bye-products industry. There were as managers of the coking plants of this country many highly trained technical men; and they would no doubt be able to provide much useful information for the benefit of the members of Gas Associations. He sincerely hoped that all had had an enjoyable visit, and had benefited thereby.

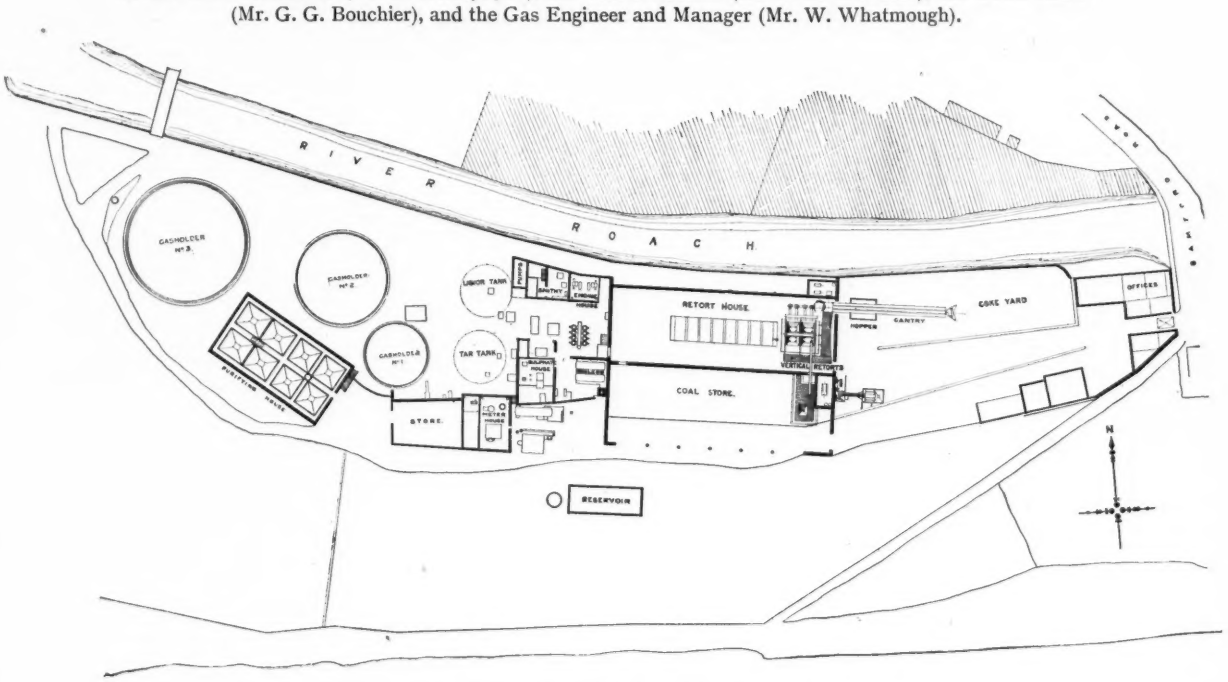
Mr. Hollingworth, responding on behalf of the members of the staff, said he was delighted to see so many present, and especially to see so many seniors. He was sure that three important results would follow from the afternoon's proceedings. First, he believed the Birchenwood officials would have learned something from the searching questions and useful suggestions of their visitors; and he was just as sure the members of the Associations could not have failed to learn something from the methods and processes they had that afternoon witnessed. He sincerely hoped that the joint meeting of the Senior and Junior Associations, so happily inaugurated that afternoon, would be the means of still further cementing the good feeling and co-operation existing between the Associations. He also alluded to the possibility of coke-oven managers being admitted to Gas Associations, and said that the Council of the Junior Association had long ago decided to recommend the members to adopt such a proposal, and only awaited a favourable opportunity to introduce the rule permitting it. His colleagues and himself were much honoured in having with them such distinguished engineers; and he sincerely trusted that the occasion would long be remembered as one on which they had spent a very pleasant time together, and added considerably to their stock of useful knowledge.

At the meeting of the London County Council to-day, the Fire Brigade Committee will present a report on the recent fatality caused by an escape of gas into a sewer in Pembridge Villas, W. (see *ante*, pp. 45, 191). They refer to the bravery displayed on the occasion by members of the brigade; and they propose that the widow of the fireman Libby shall be granted a pension of £30 per annum, in addition to the sum to which she will be entitled under the Workmen's Compensation Act.

GLOVER-WEST VERTICAL RETORTS AT HEYWOOD.

Description of the Installation Inaugurated Last Week.

THERE was inaugurated last Thursday, at the Heywood Corporation Gas-Works, a new vertical retort installation on the Glover-West system of continuous carbonization; and in connection with the ceremony, an excellent *brochure* was prepared, from which the following particulars of the undertaking in general and the Glover-West retorts in particular have been taken. The *brochure*, it may be mentioned, in addition to the illustrations reproduced herewith, and others relating to the new installation, contained photographs of the Mayor (Dr. H. Foster Jeffery, J.P.), the Ex-Mayor (Mr. A. Barrett, J.P.), the Chairman of the Gas Committee (Mr. D. Healey, J.P.), the Vice-Chairman (Mr. R. D. M'Murdo), the Town Clerk (Mr. G. G. Bouchier), and the Gas Engineer and Manager (Mr. W. Whatmough).



GENERAL PLAN OF THE HEYWOOD CORPORATION GAS-WORKS.

HISTORY OF THE UNDERTAKING.

The first Local Act to supply the town with gas was obtained by the Heywood Gaslight and Coke Company in 1826; and in 1867 the works were purchased by the Local Board. At the time of the incorporation of the borough in 1881, the capital expended was £62,690, equal to £1 4s. 4·72d. per 1000 cubic feet sold, compared with £87,687 for 1912, or 13s. 7·46d. per 1000 cubic feet. There is no record of the charge for gas previous to 1856; but at that time the price per 1000 cubic feet was 5s. 6d. net for small consumers, with a graduated discount for large consumers. At the time of the incorporation, the net price within the borough was 3s. 9d. per 1000 cubic feet, with a differential price of 5s. 7d. for Birch and 4s. 7d. for Bamford. At present the charge is 2s. 9d. per 1000 cubic feet, with a differential rate varying from 2s. 4d. to 1s. 6d. for stoves and motive power; the average price being 2s. 7d. The public lamps are charged at the rate of 2s. per 1000 cubic feet.

The Gas Committee have adopted many methods for the development of consumption, including the free hiring of grillers and boiling burners, free maintenance of incandescent burners, free cleaning of gas-fires, low rates of hire for cooking-stoves, gas-fires, wash-boilers, and other apparatus, holding gas exhibitions and lectures, and the establishment of a show-room, all of which have been of great benefit and convenience to the consumers. The number of meters in use in 1881 was 4570; and by the present year this had been increased to 8606 (6205 ordinary, and 2401 prepayment). Since the incorporation of the borough there has been a substantial increase in the output of gas, especially from 1886 to 1901; the rate of increase since the latter date being small, due to the keen competition with electricity and the adoption of incandescent and high-pressure lighting. The output of gas in 1881 was 51,400,000 cubic feet; and in 1912 it was 128,742,000 feet. Previous to the year 1890 (with one exception) no contribution in aid of the rates was given from the gas profits; but since that date the sum of £16,164 has been contributed, and £12,772 has been transferred to the reserve fund, from which renewals amounting to £6739 have been carried out.

The works and mains have been extended from time to time to meet the growing demands; but the principal alterations were carried out in 1886, when the retort-house, retort-bench, and coal-stores were rebuilt—the settings being constructed on the direct-fired system, and subsequently converted to the generative principle. As the average life of a retort-bench is twenty years, the Gas Committee seven years ago began to consider the advisability of rebuilding and modernizing the carbonizing plant; but as the question of carbonization has been in a transition state until recently, the Committee have year by year deferred the question, so that when the change was made the Corporation could avail themselves of the best and most economical plant.

In 1911, the vertical retort system of carbonization may be considered to have emerged from the experimental stage; and a Sub-Committee, consisting of the ex-Mayor and the Chairman and Vice-Chairman of the Gas Committee, were appointed to investigate and report on the modern systems of carbonization. Several gas-works were visited to inspect the various systems in operation; and eventually a report was submitted to the General Committee, suggesting that tenders be obtained for carbonizing plants, with horizontal retorts and stoking machinery, and vertical retorts, both continuous and intermittent systems, capable of manufacturing 500,000 cubic feet of gas per day.

After carefully considering the tenders, and seeing the vertical retorts in operation, the Committee, on Dec. 28, 1911, unanimously decided to recommend the Glover-West continuous system of carbonization as most suitable and economical for their requirements; and this proposal was approved by the Council on Jan. 10, 1912.

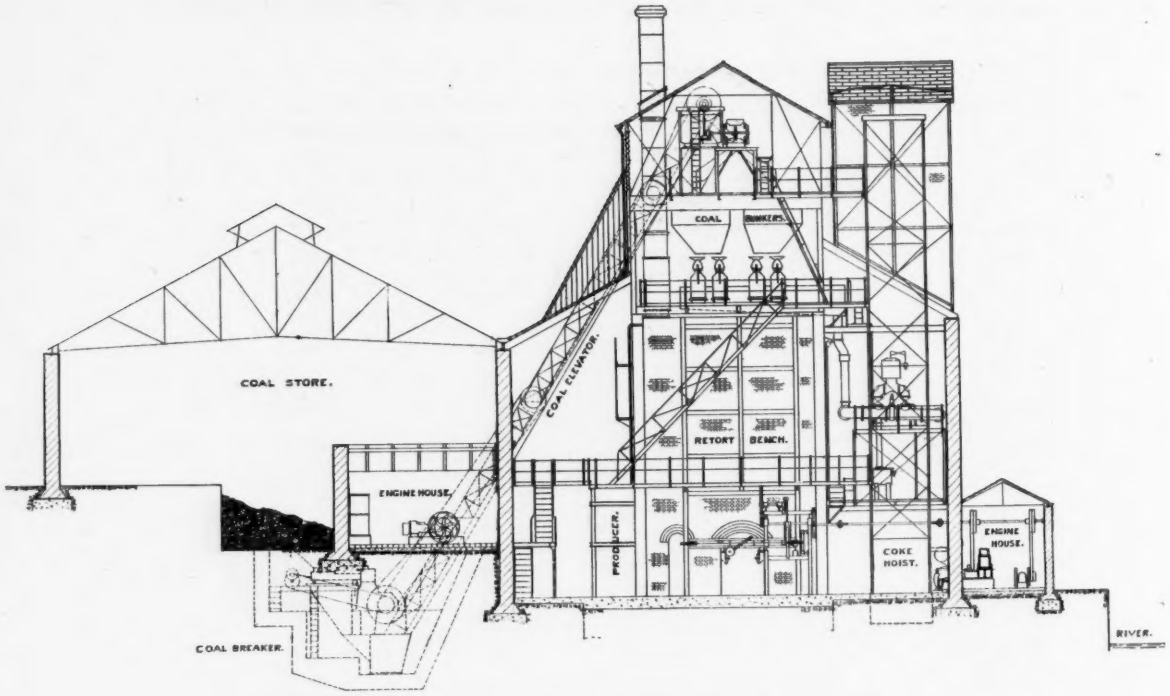
THE GLOVER-WEST VERTICALS.

The new plant has been installed at one end of the horizontal retort-house, on a site formerly occupied by an old bench of three settings, which was demolished to provide space for the reception of the vertical retort plant. The retort-house walls on one side and the gable end were increased to the height required, and a new roof provided for the portion of the retort-house occupied by the vertical retort installation.

The new installation contains two settings, each divided into units of four retorts, and heated by one producer furnace, and is complete with coal-handling plant, consisting of a coal-breaker with mechanical feeder gear, and an elevator and conveyor, for raising the coal to coal-storage bunkers fixed above the bench, and of a capacity of 24 hours' supply. The plant also includes coke-waggons for removing the coke from below the retort-bench, and a lift for raising these waggons to an elevated gantry extending from the retort-house to the coke-yard. Arrangements are also made for storing the coke in a hopper, provided with outlets for filling carts.

Power for the coal-handling and coke-extracting plant is provided by gas-engines. The coke lift is, however, operated by a totally enclosed reversing steam-engine.

The coal is brought in carts to a coal-store built alongside



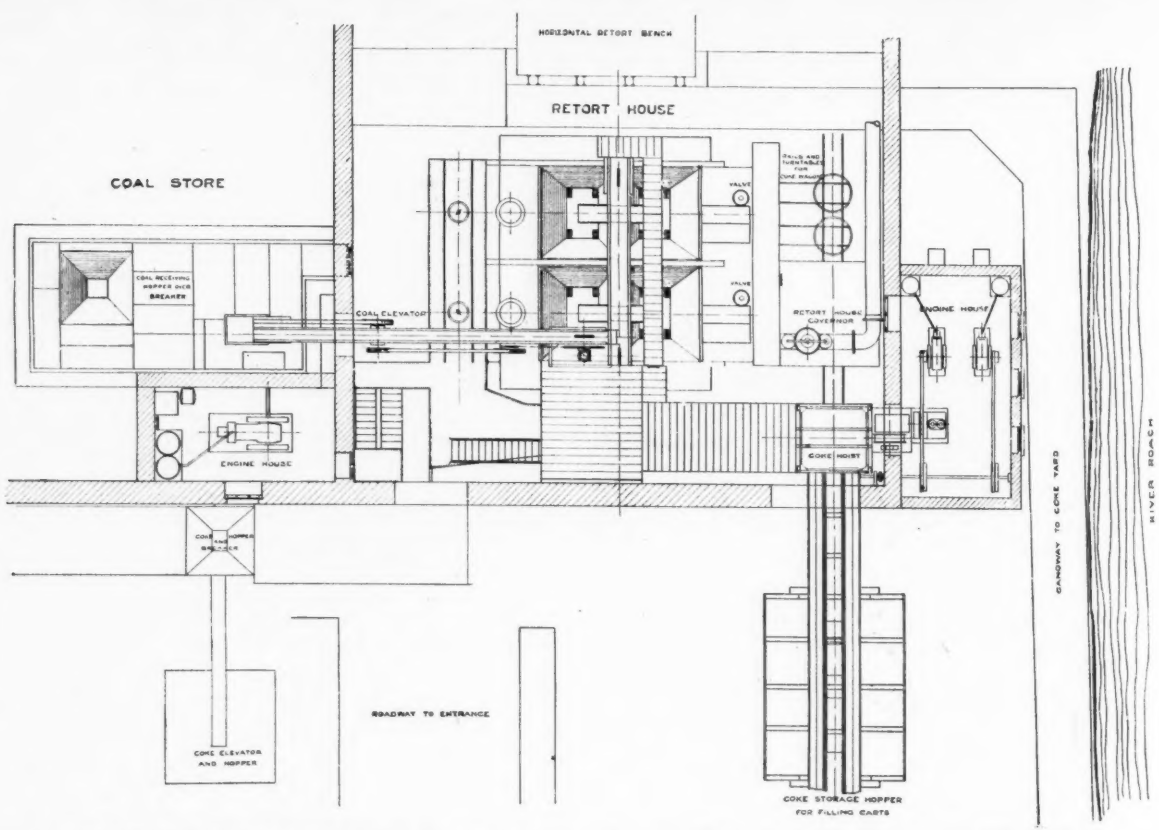
SECTION OF THE GLOVER-WEST VERTICAL RETORT INSTALLATION.

the retort-house, from which the coal is discharged direct to the coal-breaker.

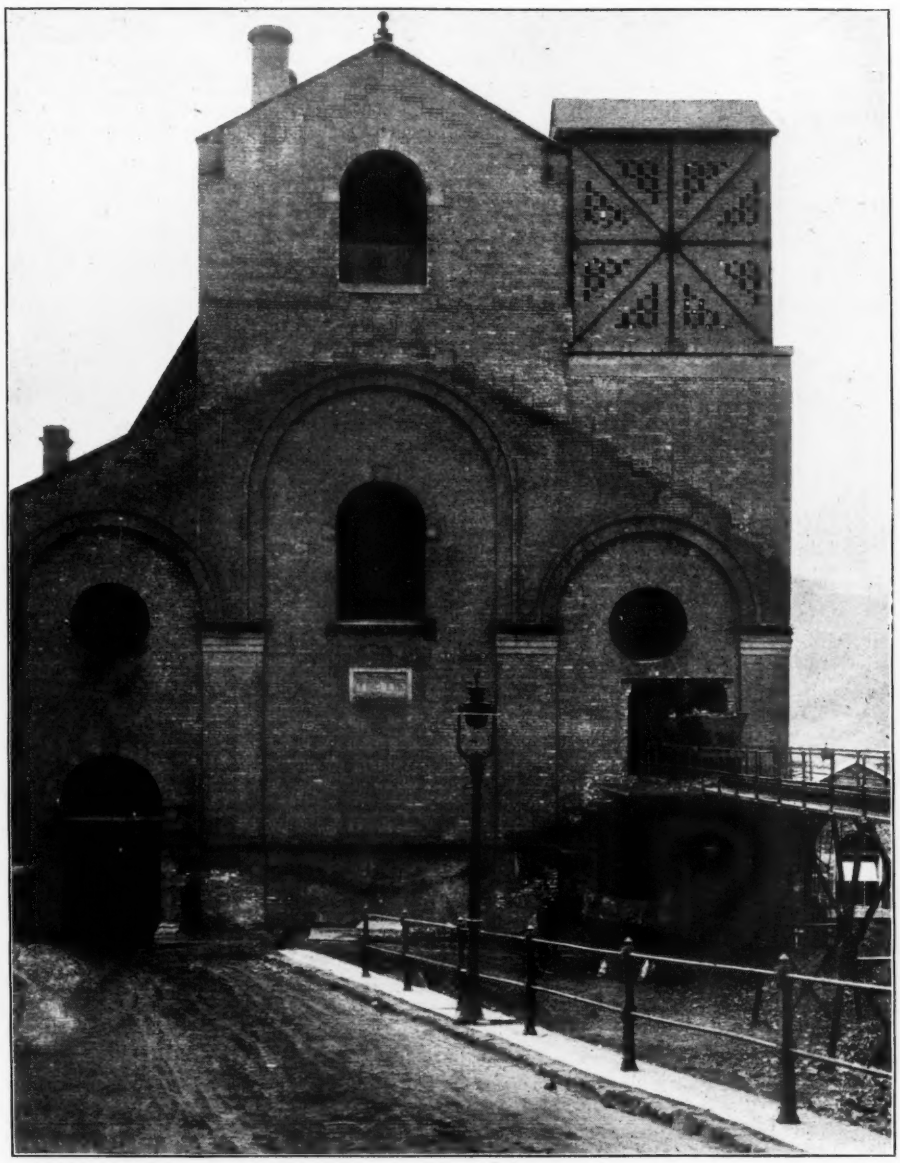
Readers are, of course, familiar with the system, the following general description of which is included in the pamphlet.

The coal, after being broken, is raised by the elevator and conveyor, and stored in coal-bunkers above the retort-bench. These bunkers are provided with outlets corresponding in number to the retorts. Below each of these outlets there is a coal-feeding hopper, which receives its supply from the coal-bunker above. This hopper is fitted with a rotary coal-inlet valve, and contains about three hours' supply to the retorts, through which the coal continuously descends, and during its descent becomes completely carbonized into coke by the time it arrives at a point at the base of the retort.

The coal, after being converted into coke, passes through the lower ends of the retorts, and is cooled by air which circulates around the bases of the retorts. This heated air forms the secondary air supply to the combustion chambers, which are arranged in horizontal superimposed floors; each floor being distinct from the other. The producer gas is supplied from a generator common to the eight retorts of the setting. The producer gas rises through vertical flues, and is admitted to the several floors through nostrils controlled by dampers. The waste gases from each combustion chamber are led through flues and circulating chambers around the top ends of the retorts, afterwards making their exit to chimneys, of which there is one to each setting. The Glover-West system of heating the retorts is unique in the design of gaseous-fired settings, as the heat from the residual



PLAN OF THE GLOVER-WEST VERTICAL RETORT INSTALLATION AND COAL AND COKE HANDLING PLANT.



GABLE END OF THE RETORT-HOUSE ALTERED TO ALLOW OF THE GLOVER-WEST INSTALLATION BEING FITTED.

coke is utilized, resulting in considerable economy in fuel consumption as compared with the ordinary regenerative system. Further, the coke is discharged from the retorts in a comparatively cool state, and does not require quenching.

For each retort there is a coke-extractor in the form of a helix, which is rotated at very slow speed by variable speed ratchet driving gear, which can be quickly adjusted to control the speed at which the coal passes through the retort—thus readily adjusting the time of carbonization to suit any kind of coal. The coke from the retort is temporarily received in coke-chambers, from which it is periodically discharged to the coke-waggons, and conveyed to the yard store.

The gas ascends in the retort to an outlet at the side of the coal-feeding hopper, and is led through a valve to a condensing main, which is provided with gas and tar outlet-valves. From the condensing main, the gas and tar are conducted through a foul main, which is provided with a retort-house governor having the usual bye-pass with valves and connections. For inspecting and attending to the various parts of the vertical retort plant, there is an ample provision of staircases and platforms; and, in addition, there is a lift, which not only serves the purpose of raising the coke required for the producer-gas generators, but is also employed for raising the coke required for filling the retorts when they are first put into operation, and after they have been scurfed. The lift also serves as an auxiliary coal-elevator to the coal-bunkers, in case of need.

The Inaugural Celebrations.

On the occasion of the inauguration of the installation of the vertical retorts at the Heywood Corporation Gas-Works last Thursday, a number of Lancashire and Yorkshire gas engineers and managers were invited to inspect the new plant. The visitors were heartily welcomed at the works by the Chairman of the Gas Committee (Councillor David Healey, J.P.), the Vice-Chairman (Councillor R. D. M'Murdo), and the Gas Engineer and Manager (Mr. W. Whatmough). A profitable hour-and-a-half was spent in the works under the guidance of the gentlemen named; the value of the inspection being enhanced by the presence of Mr. John West, of Manchester, and Mr. Samuel Glover, of St. Helens.

At the Municipal Buildings.

The visitors were subsequently entertained at tea in the Municipal Buildings—Councillor Healey presiding. After the repast,

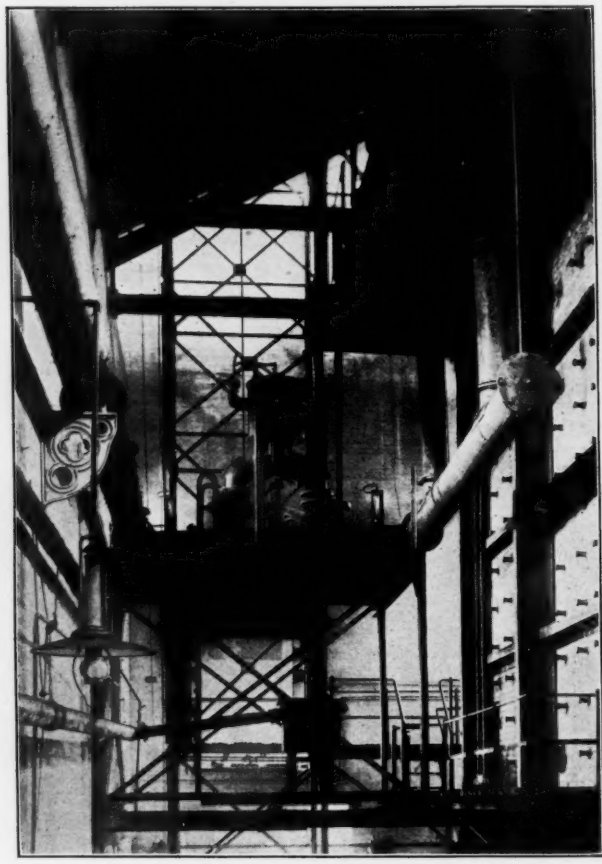
Alderman Hodgkinson, J.P. (Chairman of the Finance Committee of the Heywood Corporation), gave the toast of "The Gas Committee, and Success to the Undertaking." The veteran Alderman humorously observed that he hardly saw the necessity of proposing the health of the Gas Committee, because they were all young men, and young men ought to be healthy. In his opinion, the Committee had a very easy time; for they had in Mr. Whatmough a Gas Engineer and Manager who relieved them of all responsibility. So far as he (the speaker) was aware, the only difficulty the Finance Committee had with the Gas Committee was in squeezing additional moneys out of them for the relief of the borough rates. They were very shy in handing over any money out of the thousands they made; and while on this point, he would like to observe that, considering that the gas-works had been the property of the town for so long, the Committee might really hand over every penny they made to relieve the Finance Committee of the burdens which rested upon them.

Mr. Samuel Glover: Or lower the price of gas.

Alderman Hodgkinson said gas engineers, as well as gas committees, of course thought this was a one-sided view of things. The visitors saw from the handbook that the gas undertaking had been a pretty successful one all along the line. He coupled with the toast the names of the Chairman and Vice-Chairman of the Committee.

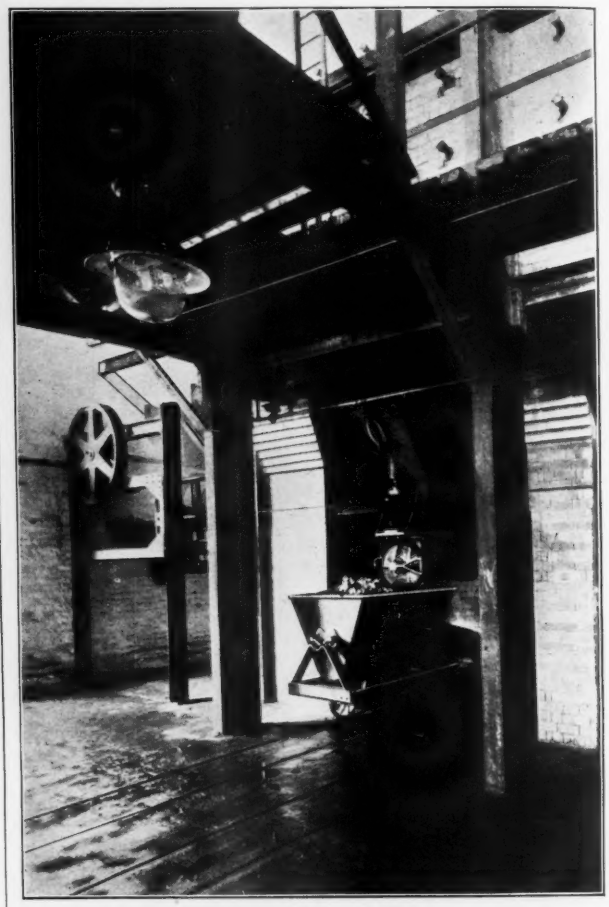
The toast was cordially honoured.

Councillor Healey, in responding, said he was glad to state that for some years the gas undertaking had not made a loss. Alderman Hodgkinson had alluded to all the profits of the Gas Department

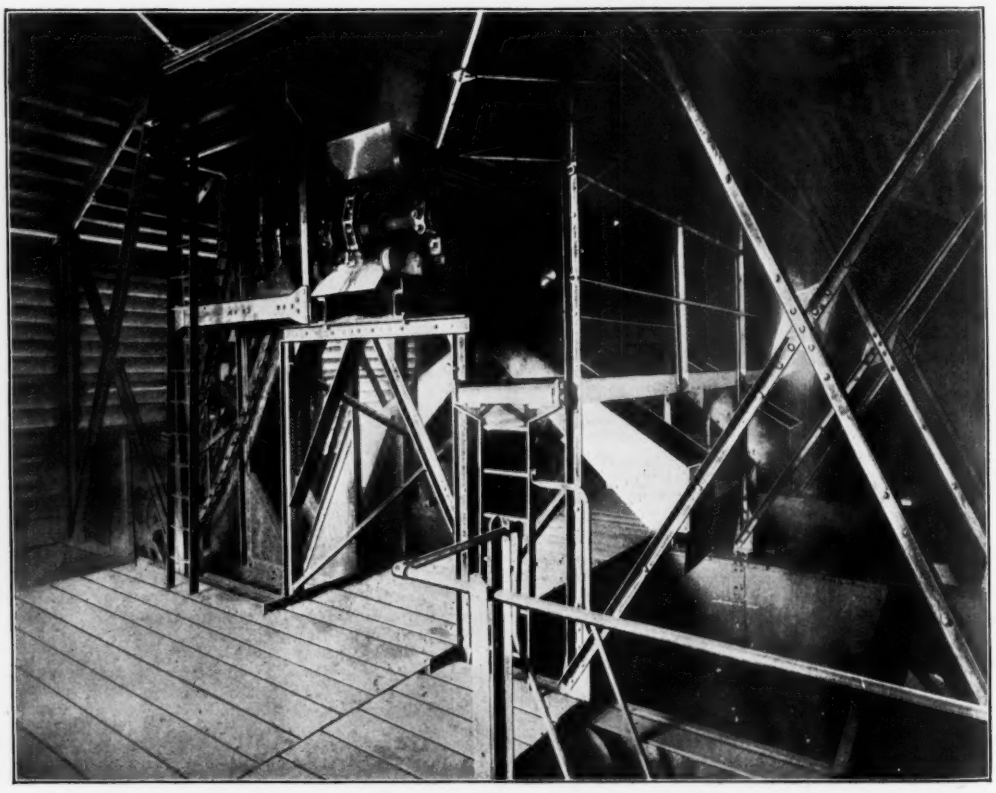


Retort-House Governor (with Connections) and the Gas and Tar Mains of the Glover-West Vertical Retort-House.

being handed over to the Finance Committee for the relief of the rates; but there was a difference of opinion on this matter. Alderman Hodgkinson had twitted them with being a "young" Committee. The worthy Alderman would have been correct in designating them a young Committee twelve months ago; but in that time they had acquired valuable experience in regard to gas-works administration. It was, however, a rather remarkable fact that for the first time for many years there was not even an Alderman on the Gas Committee. The Committee was composed of "common councillors" [laughter]; but as soon as they were elected to office they set to work to discover improved methods of gas manufacture. Their old retorts, which were erected twenty-seven years ago on the direct-fired principle, and subsequently converted to the regenerative system, were showing signs of wear; and, as the average life of a retort-bench was twenty years, the Gas Committee began to consider the advisability of rebuilding and modernizing the carbonizing plant. Their late Chairman and their Engineer,



One of the Coke Chambers of the Glover-West Vertical Retort Bench.



COAL ELEVATOR AND CONVEYOR OF THE GLOVER-WEST VERTICAL RETORT INSTALLATION.

however, were very anxious to investigate modern systems of carbonization; and after the last conference of gas engineers they inspected a new bed of retorts which had been erected in London. They next visited Droylsden, where vertical retorts were installed. It should not, however, be thought that they neglected to ascertain what improvements had been made in horizontal retorts. The Committee carefully considered the whole question of vertical retorts before deciding to recommend to the Council what was then considered by some people to be "a revolutionary method of gas making." Among the places visited was Skipton, where they were interested to see a new method of discharging and feeding the retorts. He was very pleased with the plant at Skipton, and derived a good deal of information from what he saw there. After Skipton, the Sub-Committee, composed of Councillor Barrett (ex-Mayor of the borough), Councillor M'Murdo, Mr. Whatmough, and himself, visited Wrexham.

A VOICE: With consent? [Laughter.]

Councillor HEALEY said sometimes with the Committee's consent. [Renewed laughter.] At Wrexham, which he believed to be one of the lowest-priced places where gas was produced on the horizontal principle, they were also deeply interested in what they saw. Shortly after this the Sub-Committee made the famous trip about which some of their friends caused such a stir in the Council Chamber. They visited Sunderland to see the Dessau vertical retorts. From there they went to Newcastle-on-Tyne and Wallsend; afterwards attending the Glasgow meeting of the Institution of Gas Engineers. There they had the opportunity of going through the Glasgow works with the Engineer (Mr. Alexander Wilson), who was not only one of the best-known men in gas engineering circles, but who generously gave the Sub-Committee all the information they desired. They next visited Helensburgh, where an installation of the Glover-West vertical retorts was actually constructing. This, undoubtedly, was a most useful visit, because it afforded them the opportunity of inspecting the work in what, for want of a better word, he might call the "raw state." It enabled them to see the construction in detail. Smethwick was the next place visited. There the installation inspected was on lines similar to that which they saw at Luton. When the Sub-Committee came back from Smethwick, the question with them was what type of installation they were proposing to recommend to the Committee for adoption. This was a difficult matter to handle; but they decided to take the whole of the Gas Committee to see the installations at Smethwick and Droylsden. Ultimately it was decided to recommend to the Council the adoption of the Glover-West system. To-day the visitors had seen the system working; and he thought, in the light of all their experiences, that they had done right. Alderman Hodgkinson had spoken about the Committee having generally an easy time of it. In one sense they had, he agreed, easy times, because they felt that with all they did they had the confidence of the Council. When the Gas Committee presented their report with regard to the advisability of rebuilding and modernizing the carbonizing plant, the Council, without the slightest hesitancy, passed a resolution for the immediate construction of the works. True, they had increased their capital value; but he hoped the saving which would ultimately come as a result of the adoption of the new plant would more than compensate them for the increase in the direction indicated. Referring to the output of gas in recent years, Councillor Healey went on to say that the rate of increase had been small since 1901, when it was 114,727,000 cubic feet—an increase over 1896 of 14,404,000 cubic feet. In 1906, however, the greater sale of gas compared with 1901 was only 6,743,000 cubic feet; while five years later—in 1911—the increase was only 3,861,000 cubic feet over 1906. Their sales in 1912 amounted to 128,742,000 cubic feet, which showed an increase of only 3,411,000 cubic feet over the preceding year's figures. When they criticized these figures, however, they should remember that Heywood, unlike their friends in Manchester, who had plenty of scope for increasing, and were doing so by leaps and bounds, was only a small town with little opportunities for developing on a large scale. With regard to their electrical friends, he would like to see them working together more closely. The Gas Committee, he assured them, had no thought of entering into opposition to, or competition with, the electrical undertaking. With regard to Mr. Glover's remark in reference to a reduction in the price of gas, that *desideratum* could easily be effected if the coal accounts did not reach such enormous figures every year. He thanked the visitors for honouring the toast, and for the confidence they had shown in the Gas Committee. So long as he occupied the position of Chairman, he would endeavour to secure economical production, and would let consumers have gas at the cheapest possible rate.

Councillor M'MURDO, who also responded to the toast, jocularly remarked that there was plenty of wisdom involved in the young members of the Gas Committee. This was seen by the unanimity with which they came to a decision upon the Glover-West vertical retort question when the matter was before them. [Laughter and "Hear, hear."] They realized, however, something of the arduous nature of the duties performed by members of earlier Committees, and felt that they owed them a deep debt of gratitude. They had in their Engineer and Manager, Mr. Whatmough—he might with truth call him the main-spring of the department—one who gave them of his best. He was not only careful, but cautious; and the Committee entrusted the fullest confidence in him. His was the guiding influence of the undertaking; and he had probably used this influence in restraining the Committee in deciding as to the vertical retort method of carbonization until such time as he thought the special Sub-Committee had actually decided on the best possible system on which to expend the ratepayers' money. As to the Glover-West system, the Contractors had in Mr. Bird a man who looked thoroughly well after their interests, and likewise those of the Heywood gas undertaking. The speaker concluded by referring to the eminent services rendered to the Gas Department by Mr. Healey, who, he said, was a very busy man, and whose business ramifications extended over the four quarters of the globe. Notwithstanding the fact that perhaps some of those present did not always see eye to eye with him, it would be a bad day for Heywood if they lost the services of such public-spirited men as Mr. Healey.

The MAYOR (Councillor Dr. H. Foster Jeffery, J.P.), in proposing "The Contractors," said it was only that afternoon that he had the pleasure of meeting Mr. John West, and of hearing the vertical retort system explained. After this explanation, however, he could not understand why the Gas Committee had been so long making up their minds. If Mr. West had talked to the Gas Committee of his day as he talked to him (the Mayor) that afternoon, Heywood would have had vertical retorts long ago. The Contractors had, undoubtedly, carried out an excellent piece of work at Heywood, and were worthy of the good name which they bore. [Applause.] When the visitors looked round the works that afternoon, they saw, of course, both the horizontal and vertical systems in use. It was "up to" the Contractors to show that their vertical system carried out all that they claimed for it, so that the next time the Engineer said the Heywood works required extending, the Committee would have no hesitation in coming to an immediate decision to replace the present horizontals with vertical settings. They had both Mr. Glover and Mr. West with them that day, and were honoured by their presence.

Mr. JOHN WEST, who was heartily cheered on rising to respond, said he desired to thank the Mayor for speaking so kindly about Mr. Glover and himself. The Contractors had endeavoured to fulfil to the letter their contract, even if they were a trifle late in doing so. He was not there to make excuses, but the fact was that they met with difficulties. They could not get materials on account of the railway strike; and they also met with trouble in connection with the foundations. They went down 21 feet before he considered that a satisfactory foundation had been secured. They were determined to obtain good foundations, and eventually all the difficulties were overcome. Councillor Healey had explained the care with which the Committee made their inquiries into the various methods of carbonization. He (the speaker) had seen the members of the Sub-Committee at various works they visited, and had been impressed by the conscientious manner in which they carried out their duties. As to the visit to Helensburgh (where the Sub-Committee saw the work in practical construction), he was only too delighted to welcome them there, as he was others, so that they might see for themselves the work the Contractors put in. It was essential that vertical installation work should be carried out in the very best way with the best materials. He was very pleased to find the installation working so "sweetly" that day. What they wanted in the working of the vertical-retort system was not so much muscle as brains. He had found there was plenty of intelligence among workmen if they were properly guided and directed. Some folk—not Heywood people—appeared to hold the idea that if the men's work was easier they should be given less wages; but he said, "No; give the men more for their intelligence." This was the line he had gone on all his life in connection with the working of machinery generally. A great amount of manual labour now lost could be more scientifically employed if greater attention was paid to the laws of gravitation. This was why the vertical-retort system rendered labour less arduous; and, by means of the various mechanical contrivances, even coke-handling was now reduced to a minimum. In a short time they would require a new retort-house; and one of the advantages of the vertical system was that they could make double the quantity of gas on the same area, so that the retort-house as it now stood would increase the capacity of the old plant two-fold. This was a most important advantage in undertakings which were cramped for room. He had no fear as to the results at Heywood coming out all right. At Lurgan—the smallest place where the vertical system was established (a 44 million works)—the Engineer stated that the verticals had turned out much more satisfactorily than they had anticipated. The actual working results were even better than the experiments; and they acknowledged getting better results from tar. At Helensburgh—a 68 million works—they were also getting better results than anticipated. Mr. T. Banbury Ball had already pointed out in the "JOURNAL OF GAS LIGHTING" what he was achieving at Rochdale. He had not yet had a complete year's working. The results, however, were, in that instance, also stated to be better than anticipated. When the Heywood authorities obtained the actual returns of the working of the new plant, he was confident they would be quite satisfied. From a sanitary point of view, too, vertical retorts had turned out to be of considerable advantage. There was, for instance, the absence of smoke, dust, and steam nuisances. Nothing, however, appeared to have been done until recently for small or moderate sized works like Heywood; attention having been chiefly confined to the requirements of large undertakings. But the inquiries which his Company were now receiving from small undertakings were very considerable. What gratified him, moreover, was that they were already getting duplicate orders from companies and corporations who had had the vertical system installed. The inquiries, too, from abroad were most encouraging; and his son was now in the Colonies in connection with an important matter. "I shall not treat him kindly," added Mr. West, with his usual *bonhomie*, "if he returns with less than £100,000 worth of contracts." [Laughter.] Mr. West broke off at this stage of the proceedings and called upon

Mr. SAMUEL GLOVER, who also expressed the pleasure it afforded him to be present that afternoon. It might be within the recollection of their veteran friend Alderman Hodgkinson, who was once Chairman of the Heywood Gas Committee, that at one time his (Mr. Glover's) ambition was to become Engineer and Manager at Heywood. This was, however, long before his friend Mr. Whatmough was appointed to the duties. But now that he had seen the working at Heywood of the vertical retort system with which his name was associated, any feelings of sorrow that he had in not serving the Heywood Corporation were minimized, because he had had the opportunity of serving them in another capacity. He was very pleased at his name being coupled with that of Mr. John West in the toast that had been so heartily honoured. He was not a contractor, although he was closely associated with Mr. West, and had been throughout his life, as a gas engineer. This was, in fact, one of the reasons he had every confidence in going to Mr. West with such ideas as he had about vertical retorts. He desired to say that this system of carbonization was now very far removed from the experimental stage. At St. Helens, they received from all parts of the world visitors who were anxious to inspect the vertical settings. He could bear out every word Mr. West had said as to his determination to get at the difficulty experienced at Heywood in regard to the "doubtful ground." Mr. West, he knew, intended to put in proper foundations, at whatever cost to the firm, in a way that their

Engineer (Mr. Whatmough) would say was thoroughly satisfactory. After congratulating the Committee on the adoption of up-to-date appliances for consumption-increasing purposes, Mr. Glover concluded by stating that wherever the Glover-West system had been adopted it had more than fulfilled the expectations of engineers who recommended its adoption.

PRESENTATION TO THE CHAIRMAN.

Mr. JOHN WEST at this point handed to Councillor Healey a handsome rose-bowl on oak base, on behalf of the Contractors, and expressed the hope that it would always afford him an opportunity of recollecting their pleasant associations. The inscription was:

> Presented to Councillor David Healey, J.P., Chairman of the Gas Committee of the Heywood Corporation, on the Occasion of the Inauguration of the Glover-West Vertical Retort Installation, April 17, 1913.

Mr. HEALEY having returned thanks for the gift, which he said he accepted with pleasure and would always value,

Councillor C. COUPE, J.P., proposed the "Town and Trade of Heywood."

Alderman HEALEY, in responding, remarked that it afforded him pleasure to hear that there was some possibility of a reduction being made in the price of gas, as well as improved labour conditions for workmen, as the result of the installation of the vertical retort system. He urged the need for closer combination between capital and labour—indeed, he regarded them as twins. It was highly essential that there should be reason on both sides.

Alderman POPPLE also responded.

The EX-MAYOR (Councillor Barrett), to whom was entrusted the toast of "The Visitors," spoke of the work of the Special Sub-Committee in inspecting various gas-works. They were, he said, received with the greatest courtesy everywhere they went; and every possible piece of information was placed at their disposal. The speaker went on to refer to the excellent work now being done by the British Commercial Gas Association, and remarked that anyone who had watched the development of this enterprise must have recognized that the gas fraternity were now taking full advantage of modern methods of bringing their product to the homes of all. He cordially proposed "The Visitors," most of whom were subscribers to the Association.

Mr. WHATMOUGH was accorded a hearty reception on rising to allude to the courtesy of visiting engineers. He thanked all those officials and engineers with whom they came in contact during their investigations in connection with vertical retorts. He was, however, convinced that they had done the right thing at Heywood in deciding on the Glover-West system. He concluded by stating that no engineer ever had a Chairman who so loyally and cordially supported him in his work as he had. [Applause.] He also desired to thank West's Gas Improvement Company, Limited, for the help they had rendered him. He trusted the new installation would prove of great benefit not only to the Corporation but to the ratepayers generally.

Mr. T. DUXBURY (Oldham) responded, and the proceedings then terminated.

GARW AND OGMORE GAS COMPANY'S NEW WORKS.

Opening Ceremony at Brynmenin.

NEW works at Brynmenin for the Garw and Ogmore Gas Company were started last Tuesday by Mrs. Fisher, the wife of the Chairman of the Company (Colonel H. Oakden Fisher). Hitherto the Company have confined their operations to the upper part of the Garw Valley, where they erected works in 1895, with a small paid-up capital of £2661. But by the introduction of the slot meter and the undertaking of public lighting, they have gradually extended the enterprise, increasing the capital and raising the dividend to 6 per cent., which has been maintained since 1905, with allocations to reserve. Further powers were obtained in 1908, enabling the Company to build the present works, which are designed at the fork of the valleys, to supply gas to the whole of the Garw, Ogmore, and Gilfach Valleys, all of which are rapidly developing. The works are arranged to produce 30 million cubic feet per annum, and are capable of being enlarged to produce double this quantity without alteration to the buildings. The new works were designed by Mr. Sydney Murray (the Company's Engineer and Manager), who was complimented by the Chairman on the successful outcome of his labour. The praise was, in fact, well deserved, for Mr. Murray and the Contractors have had great difficulties to contend with, and have surmounted them all in a completely satisfactory manner. The contract for the entire works was placed with Messrs. R. & J. Dempster, of Manchester; the foundations and buildings being carried out under their supervision by Mr. P. Gaylard, of Bridgend. The contract for the whole of the work in connection with the fitting-up of the houses is in the hands of Messrs. Willey and Co., of Exeter.

DESCRIPTION OF THE WORKS.

The site upon which the new works are built lies rather low; and the general ground line has been raised about 2 feet. Hence there is a lot of space for general filling-up that will absorb waste material for some years. Unfortunately, water was found in some cases directly below the existing ground-level; and as the works were constructed during one of the worst seasons experienced in the locality, erection has only been completed under the greatest difficulties. There were water troubles over the site generally, yet where the retort-house is situated no water was found—which shows discretion in selecting the various positions.

Provision is made for the extension of all apparatus as future needs arise; and owing to the shortage of house accommodation in the neighbourhood, the Company are building cottages for their employees alongside the adjoining highway. The railway runs upon an embankment about 15 feet above the level of the works; and full advantage has been taken of this to deliver the coal from an overhead siding into the coal-stores. Owing to engineering difficulties, the siding is not yet fixed; but the work is in hand, and the Company hope that material will soon be delivered in this way.

A steam-hoist is employed to raise the coal from the ground floor to the stage floor of the retort-house; and the same type of apparatus will eventually be fixed against the retort-house and coal-store, so as to raise coke from the yard and deliver it into waggons on the overhead siding. The hoist will also be available for dispatching other material; and generally the works should be operated in the most economical way. The design of the buildings is uniform throughout; and they present an excellent appearance, having been built with good local stock bricks, with special facing bricks at plinth courses, sills, heads, string courses, &c. They are of a substantial character, without any excess of material where not required.

The retort-house and coal-store occupy a space 50 feet wide by 48 feet long, having a temporary end formed of corrugated sheeting to allow for further extension. The roof is in two spans, supported by steel stanchions, which also carry the charging floor and the cross girders for the overhead railway in the coal-store. The retort-bench comprises three arches, each containing eight 22 in. by 16 in. ⏢ retorts, heated on the regenerative principle. The bench is excellently braced, and the fittings are of the most modern character. The arch-pipes are of the Darwen type, the cover of which is supplied with water, and a drip arrangement fitted over each ascension-pipe. This type of arch-pipe, it is pointed out, has been supplied to many works, and has proved an effective remedy for ascension-pipe stoppages. The tar-mains are coupled to a tar-tower; and a retort-house governor is provided on the foul main. The stage floor is covered with chequered steel plates supported on rolled steel joists, while the coal-store and lower floor of the retort-house are paved.

The next block of buildings has been excellently laid out. First there is the sulphate of ammonia plant, which is capable of producing 3 tons of salt per week. It is constructed on the continuous principle, and is of the most up-to-date character; the main and secondary stills having excellent facilities for interior examination. The whole of one side is clear of any fittings, and may be removed in sections, thus allowing the interior to be examined, removed, and replaced with a minimum amount of trouble. The stills are fitted with automatic safety and blow-off arrangements, and operate at a very low steam pressure. The saturator for the plant was supplied and fixed by Messrs. Joseph Taylor and Co., of Bolton, and is of their solid lead description. The main acid store tank has been fixed on the outside wall of the coal-store, and in such a position as to permit the acid to run into it from the overhead railway, yet with sufficient head to deliver into the supply tank fixed inside the sulphate-house. Thus there will be no necessity for any lifting or handling of the acid in any way.

The boiler-house is fitted with a Lancashire boiler, 6 feet diameter by 18 feet long, fitted with Galloway tubes, and has a working pressure of 100 lbs. per square inch. The house is arranged to take a second boiler, and is in the most convenient position to supply steam to the apparatus surrounding it.

A partition wall divides the boiler-house from the exhauster and compressor house. There are two exhausters, one having been removed from the old works at Pontycymmer and refixed. The new exhauster has a capacity of 11,000 cubic feet per hour, and is of Dempster's three-blade rotary type, having a horizontal steam-engine, and being fitted throughout with all the latest automatic arrangements.

A high-pressure plant has been supplied by the Bryan Donkin Company, and will be utilized for delivering gas to the whole of the districts. Gas will be supplied from these works up the Garw and Ogmore Valleys—a very extensive district of supply Thus high-pressure gas was recognized as being the most economical method of distribution. The compressors are in duplicate, and each capable of delivering 30,000 cubic feet of gas per hour against a pressure of 9 lbs. per square inch. The size of the compressing plant having been increased beyond the original design, very little space is left in the exhauster-house, other than that required for actual operating and attention. The gas is supplied into the existing holders at Pontycymmer for the Garw Valley as well as for the Ogmore Valley. It is governed-down and supplied into low-pressure mains by means of two Reynolds district governors. All services at intermediate points are governed-down by service regulators. The whole of the jointing of the steel tubes, both high and low pressure, was done with lead wool, which has given entire satisfaction. Before being covered in, the joints were tested up to 40 lbs. pressure.

The pump-house is provided with two horizontal steam-pumps, one for liquor and one for water, each capable of dealing with 1500 gallons per hour. The tar-pump is capable of dealing with 750 gallons per hour, and is so coupled as to deliver the tar into the railway waggons on the overhead siding when desired. Covering the pump-house, and forming the roof over it, is an overhead supply tank, 23 ft. by 12 ft. by 4 ft. 6 in. deep, divided into two compartments, one for water and one for ammoniacal liquor—the former for supplying water to the works generally, while the latter will allow the liquor to gravitate to the ammonia stills.

The meter-house, which is placed near the gasholder, contains a 10,000 cubic feet per hour station-meter. The condensers are of the annular type, each 22 ft. 6 in. high, the inner and outer shells being 22 inches and 32 inches diameter respectively. Each condenser is fitted with the usual wing-valve, tar connections, &c., and the whole is arranged for bye-passing, should such necessity arise. The washer is of the Livesey type, having a capacity of 250,000 cubic feet per day, and is so arranged that the liquor overflows from the tower-scrubber automatically through it. The scrubber is 6 feet diameter by 40 feet high, and of Dempster's make, filled with boards. It is provided at the summit with pent house and tank, having an automatic water-tippler ; while half-way up the scrubber a liquor distributor is fitted.

The purifiers are three in number, provision being made for a fourth. Each is 12 feet square by 5 feet deep, fitted with Spencer's hurdle-grids. The boxes are worked by means of a 12-inch Weck valve ; provision being made for connecting-up to the extra purifier. This valve has the "Bearscot" improvements, whereby rising and falling discs may be rotated when being moved into position. An improved type of rubber joint is employed for sealing the covers, which ensures the rubber frame being raised with the cover rigidly, and always retained in position. Alongside the purifiers is the revivifying floor, an open curved roof covering both this space and the boxes ; for the excessive rainfall makes it impossible to revivify the oxide of iron except under cover.

The gasholder is of the Dempster improved spiral type, and is contained in a steel tank. The foundations for the latter are about 3 feet below the surface of the ground; and during construction considerable difficulty was experienced owing to water springs. The tank is provided with a ladder and balcony, and contains a two-lift spiral holder 62 feet diameter by 22 feet deep. To gain access to the crown of the holder, a Davey patent ladder has been provided. The guide-carriages throughout are formed of steel. The "Bearscot" specialities are applied in the form of spiral rail-plates, extended side-sheets, &c.; and the gasholder has been so placed that the best possible use of the site has been made to provide for future storage as required.

A suitable tar and liquor separator has been placed between the tar and liquor tanks ; the whole being fixed in the most convenient position on the works. The bottoms of these tar and liquor tanks are made of concrete, while the sides are a combination of brick and cement. In the construction, two rings of brickwork were built, leaving a cavity which was filled in with cement grout. Steel joists are utilized to cover the tanks ; these having been arched over with brick and concrete. The liquor tank is 25 feet in diameter by 10 feet deep ; while the tar-tank is 18 feet diameter by 10 feet deep. The works connections throughout are 12 inches diameter for gas, while the tar and liquor connections are 6 inches diameter, with 4-inch branches leading to each apparatus. This large size obviates troubles that are usually associated with small sized tar and liquor pipes. A well has been sunk to provide the necessary water supply to the works.

A block of buildings at the entrance to the works only forms part of the complete scheme for offices, workshops, &c.; Mr. Murray having drawings showing a two-storey building, comprising general office, manager's office, weigh-office, workshops, showroom, store-rooms, lavatory, conveniences, &c., which will be carried out as the requirements of the works demand.

Opening Ceremony.

Among those present at the opening ceremony were the Chairman of the Company (Colonel H. Oakden Fisher), the Directors, the Engineer and Manager (Mr. Sydney Murray), the Secretary of the Company (Mr. T. Redford Jones), Mr. J. W. Scott (of Messrs. R. & J. Dempster), Mr. S. Powell (Clerk of Works), and a number of local gas engineers.

The ceremony of turning on the gas having been performed by Mrs. Fisher, the wife of the Chairman,

Colonel FISHER gave a review of the history of the Company, who, he said, obtained their first Act of Parliament in 1891, and erected the works at Pontycymmer in 1895, with a paid-up capital of £2661. Slot meters were introduced in 1898, and a small profit was made ; the Company declaring two years later a dividend of 2 per cent. on a capital of £4905. Terms were arranged with the District Council for public lighting ; and in 1902 a Provisional Order was obtained for increasing the borrowing powers. In 1904, the capital was increased to £10,878 ; a profit of £833 was made ; and a dividend of 5 per cent. was paid. This was increased to 6 per cent. a year later ; and this dividend had been paid ever since. A sum of £500 was placed during the present year to the reserve fund. This reserve would enable the Company to continue to pay a similar dividend while the new capital was on the way to earn a return. In 1908, the Company obtained a further Act of Parliament, enabling them to build the present works and to raise additional capital. The original 10 per cent. capital had now been subscribed, and £15,670, the balance of £20,000 of 7 per cent. capital, was for disposal. Before adopting the new scheme, the Company had three plans before them—to supply from the present works, to erect new works in Ogmore for Ogmore alone, or to erect a complete works at the junction of both valleys, and supply the whole district from there. As the old works were not capable of efficiently dealing with the increased demand for gas for the district then supplied, it would have been necessary to entirely re-build the works ; and as they were not conveniently situated for dealing with incoming and outgoing materials, the Directors decided that the future interests of the Company would be far better served by adopting the third scheme. Until recently, the objection to erecting works at the junction of the valleys was the question of long lengths of dead-main ; but this had been overcome by supplying gas under pressure through small steel tubes, thereby reducing the cost considerably. The cost of laying a large main from the works would have been about £8000 ; whereas the cost of the present main was only £3300. In 1907, the quantity of gas supplied was 12,622,900 cubic feet ; in 1912, 18,042,600 feet. The Company's area of supply covered 40 square miles, and they had laid about 16 miles of mains. The Directors believed they had a model plant, and he was very much indebted to Mr. Murray for what he had done. Mr. Murray was a young man who was destined to win for himself a high place in the world of gas. The whole of the work had been admirably done.

Mr. Scott then presented Mrs. Fisher with a gold bracelet set with opals, as a memento of the occasion ; and after a few remarks from Mr. Murray and Mr. Salathiel, the company were invited to partake of light refreshments.

Gas from Sewage Sludge.

According to the Berlin Correspondent of the "Sheffield Daily Telegraph," the Municipality of Frankfort-on-the-Main are preparing to dispose of the sewage of the city by converting it into illuminating and heating gas. By so doing they expect to cover the entire cost of sewage purification and to have a considerable sum in hand. They base this calculation on the experience of the city of Brunn, the capital of Moravia, which, after six years of experimenting, has discovered that the conversion of sewage matter into gas is by far the most profitable, convenient, and hygienic way of solving one of the most troublesome problems which face great cities. Particulars of this scheme were given in the "JOURNAL" for Dec. 31, 1912 (p. 1043). In addition to Frankfort, several other German towns are, the above authority states, experimenting on this manner of disposing of sewage ; and the system has attracted attention outside Germany. A meeting was lately held at Marseilles of experts from all the large towns of France ; and a plan was considered for introducing the system generally. The daily yield, it is stated, would be about 35 million cubic feet of lighting gas and nearly 170 tons of ammonia, having a value of about £8000.

Destructive Distillation of Sewage Sludge.—A recent number of the "Journal of Industrial Engineering Chemistry" [1913, No. 5, pp. 186-189] contained an article on the above subject by Messrs. A. H. Fiske and R. B. Earle ; and an abstract of it given in the current number of the "Journal of the Society of Chemical Industry" furnishes the following particulars: At Worcester (Mass.), the sewage, which contains large quantities of soluble iron salts, is treated with lime, allowed to settle, and the sludge filter-pressed. The authors' experiments were made with the cakes (about ¾ inch thick and containing 72 per cent. of moisture) from the presses. The cakes dried to a brown friable mass in ten hours in a current of warm air (70° to 80° C.) or in about four days at the ordinary temperature. The distillation experiments were made with 60 grammes of the dried material in a small iron retort ; and the best results were obtained by leading the distillation products through an iron coil heated to redness before conducting them to a condenser and a gas-washing bottle containing sulphuric acid. The results obtained indicate that in this way the dried sludge yields about 19·1 cubic metres of gas per 100 kilos. (6850 cubic feet per ton), 13 per cent. of tar similar in appearance and odour to ordinary gas-tar, 0·27 per cent. of ammonia, and 58·3 per cent. of a black friable residue containing from 18 to 19 per cent. of carbon, and also chlorides, sulphates, phosphates, carbonates, iron, and calcium. The percentage composition of the gas was: CO_2, 18·4 ; C_3H_4, &c., 15·9; O_2, 0·7 ; CO, 7·5; CH_4, 13·8 ; H_2, 28·2 ; N_2, 15·5.

STANDARD CLAUSES FOR INCLUSION IN A SPECIFICATION OF STREET LIGHTING.

By A. P. Trotter.

[Extracts from a Paper submitted to the Illuminating Engineering Society last Tuesday.]

In this paper the author furnished an account of the work of a representative Committee appointed early in 1911 to draw up a standard specification for street lighting, and gave in appendices a series of standard clauses for inclusion in a specification, and draft requirements for a street photometer. He did not read the paper, but submitted it with some introductory remarks. The following are extracts from it, with the two appendices.

The author commenced his paper with a few general observations on standardization, which he said is one of the features of engineering industry of the present century, and then passed on to deal with the

Constitution of the Committee.

The Committee came into existence under the following circumstances: At a meeting of the Institution of Electrical Engineers on Nov. 24, 1910, Mr. Haydn T. Harrison read a paper; and in the course of the discussion upon it, Mr. C. P. Sparks suggested that "the Institution would do a great public service by appointing a Committee which would draw up a standard specification for street lighting. . . . The specification should be drawn up on broad lines, taking into consideration not only the electrical and gas interests, but also what is wanted in the public interest." A preliminary memorandum was prepared in January, 1911, by Mr. Frank Bailey, describing the ordinary contracts per lamp and the vague reference to candle power, without any mention of angles or position of test and the advantage of specifying that which has really to be paid for—viz., the actual light given where it is required, or, in other words, illumination. The memorandum went on to indicate the lines on which a tender for street lighting might be drawn; and a first draft of the heads of agreement on these lines was provisionally settled at a meeting held on the 24th of January.

A Committee was appointed, consisting of representatives of the Institutions of Electrical Engineers, Gas Engineers, and Municipal and County Engineers, and the Illuminating Engineering Society. The members representing the Institution of Gas Engineers were Mr. W. Doig Gibb, Mr. S. Y. Shoubridge, and Mr. Robert Watson; but Mr. Gibb resigned in November, 1911. Mr. J. W. Bradley, the City Engineer of Westminster, was co-opted by the Committee as an independent member.

At an early stage, it was settled that, if a draft specification could be agreed upon, it should be presented by the delegates of each Institution to their Council, and that until these had taken action the deliberations of the Committee should be in private. At a meeting on the 7th of March, the draft was further discussed, and it was provisionally agreed as follows:

1.—The specification to be based on illumination, the unit to be the foot-candle.
2.—The standard of comparison to be the minimum horizontal illumination at a height of 3 ft. 3 in. above the ground-level.
3.—The maximum horizontal illumination at a height of 3 ft. 3 in. above the ground-level shall not be more than — times the minimum.
4.—When the horizontal illumination cannot be conveniently measured, or is below the useful range of the instrument available, it may be calculated from observed data.

At this meeting several members raised objection to basing the specification on illumination instead of candle power; and it was agreed that Mr. Trotter should prepare a statement supporting the first clause, and that Mr. Harrison should prepare a statement of objection to it.

At this point, the account of the work of the Committee is interrupted, and an attempt is made to present and to amplify the two statements, and to discuss in as impartial a manner as possible the general subject, which was debated at some seventeen or eighteen meetings.

Competition in Street Lighting.

Before dealing with the two statements just referred to, the author made some remarks on the above subject. He pointed out that until the beginning of the present century, though gradual improvements had been taking place in both electric and gas lighting, the demand for better street illumination was insignificant. As in certain other developments of civilization, this demand was created by the supply. More powerful lamps, owing their existence to research stimulated by competition, were offered by the makers before they were asked for by the purchasers. During the last few years, a real necessity for better street lighting has arisen, owing to the increasing speed of motor traffic. Mr. Trotter says: "Neither the gas nor the electrical engineer is afraid of competition—on the contrary, they thrive on it; and the public gain more than anybody, though they know nothing of the science, of the art, or of the sport of the struggle. In a great contest, sporting instinct calls for the laws of battle and the rules of the game. In this spirit, delegates from opposing camps, captains from rival schools, met round a table to devise a broad standard specification for street lighting."

Objections to the Illumination Basis.

After some general observations on illumination, the author proceeded to deal with the objections raised to its adoption as a basis of a specification. In the first place, the contractor complained that it gave him some trouble in calculating and designing his scheme. A contractor of the old school would like a laboratory test of candle power on a sample lamp, and he could then turn them out by the hundred. He is now aware that the polar curve of light distribution must be taken into account, or, at all events, the candle power at certain specified angles. Such a contractor holds that the means should be separated from the end. It is his business to sell the lamps, and in some cases to provide the electric or gas supply; but he considers that, so long as the lamps give the specified candle power, his responsibilities should end there, and the purchaser must arrange the lighting to suit the needs of the case. This school of contractor is not to be disparaged. He knows his business; he has done what he has been asked to do. We are building on the foundations he has laid.

On the other side is the municipal or county engineer or surveyor. Experienced men of this profession have studied the needs of their district, know what the contractors can provide, and understand how to use it when they have got it. It is to them that we should naturally turn for advice about a specification for street lighting. But we find that while each man knows his own job, he sometimes has a difficulty in appreciating the needs of a totally different district, and cannot generalize, or even explain, the principles on which he successfully designs his street lighting. He may classify lamps as giving 3000, 1800, 300, 180, and 90 candle-power, and arrange them to suit the streets of the district in which he has spent most of his life; but this is not a very useful guide for other engineers.

Now that illuminating engineering—the subject of many books and of courses of lectures at technical colleges—is becoming recognized as a branch of the great profession, the question arises: How much of this is the province of the borough engineer, and how much of the contractor? While there are notable instances of municipal engineers who are well able to look after their street lighting, to settle the position of each lamp, its height, the character of the reflector, the angles at which they think the candle power should be measured, it cannot be expected that the majority are anxious to go into the details of this subject, nor would they be willing to lay these before their street-lighting committees. It seems better that the lighting authorities should settle what it is they want to buy, and, having specified it, to leave details to the competitive skill and wider experience of contractors.

What, then, are these authorities "out to buy"? Not lamps, not candle power, but illumination. The needs of different cases of street lighting differ among themselves more widely than do other services; but so long as there is as high illumination in the main streets as the town can afford, and as much in the side streets as the ratepayers desire, candle power *per se* does not concern them, and need not greatly trouble their engineers or surveyors. A specification based on illumination will allow the better grades of street lighting in different towns to be accurately compared.

Another objection to the illumination basis arises from the impression that it is easier to measure candle power than illumination. It is desirable that details of photometers should be excluded from this paper and from the discussion which it is hoped to raise. But since the question of measurement constitutes an objection to the illumination basis, this matter cannot be disregarded. The draft specification to be found in Appendix A recognizes several classes of illumination; the lowest having a minimum of 0·01 foot-candle on a horizontal plane 3 ft. 3 in. above the ground. While these classes are of importance so far as quality is concerned, they cover only about 20 per cent. of the street lighting of this country. It is proposed that the balance of 80 per cent. shall be measured by candle power.

The most enthusiastic supporters of the illumination basis agree that there are instrumental difficulties in measuring very low illuminations. Photometers exist which give a good measurement at 0·002 foot-candle; but the light reflected from the clouds on a dark night or from mist or smoke is difficult to separate from low illumination due to feeble and distant artificial light. In order that the number of qualified photometers may not be reduced, the limit of 0·01 foot-candle has been fixed; but where correction has to be made for stray light or for steady moonlight, the photometer should be able to give a good measurement at 0·005 foot-candle. This applies equally to candle-power photometers, and is equivalent to a 16-candle lamp at 63 feet. There is also an instrumental difficulty in measuring illumination which falls on a horizontal

screen at a large angle of incidence. The draft specification does not provide that the screen shall be horizontal. If desired, it can be inclined to face any lamp, or, in other words, to receive the direct ray at zero angle of incidence.

In the case of that class of street lighting which constitutes by far the largest proportion, and particularly in the extreme case such as the lighting of a country road, the lamps serve mainly as beacons. The illumination on the ground or on any other surface is only useful in the immediate neighbourhood of each lamp. Candle power is obviously then the basis. It is an advantage that the light shall be thrown to a distance; and it is therefore proposed that the candle power shall be measured in the direction of the thoroughfare, at an angle of 10° below the horizontal. The direction of the road is mentioned in order that advantage may be taken of any reflector which helps the lighting in this respect. This means that the ray strikes the ground at a distance from the post measured along the street 5·67 times the height of the lamp. As it is convenient to make the measurement at 3 or 4 feet from the ground, this must be subtracted from the height of the lamp. With a 20-candle power lamp 12 feet high, a photometer 4 feet high will receive the 10° ray if it is placed 45 ft. 4½ in. from the post. The illumination on a photometer screen facing the lamp will be 0·0094 foot-candle. A smaller angle below the horizontal would mean greater distance or a higher photometer; a larger angle would mean a less important ray. Until the class of street lighting is reached which would be produced by a row of 12½-candle lamps on posts 10 feet high and 50 feet apart, or 50-candle lamps on posts 17 feet high and 100 feet apart, or any of the 200 cases given in the table attached to the specification, it is proposed that this simple measurement of candle power shall suffice.

But for the more brilliant, though less frequent, classes of lighting, where there is no difficulty in measuring the illumination produced, there are several reasons for adopting this as a basis instead of candle power. The first one has already been mentioned. The public want light, not lamps. Another reason is that this allows the fullest scope for invention, economical spacing, and minimum cost. A third is that if more than three or four lamps contribute the lighting of any part of a street, the resulting effect cannot be obtained by measuring the candle power of each lamp from that position. The addition of these candle powers gives no indication of the lighting of the spot in question, unless reduced by calculation to the resulting illumination. Nor does the measurement of the illumination on a screen facing each lamp in turn help matters, since it never faces them all at the same time. But if a horizontal screen is set up at this spot, it receives illumination from each lamp, and the illuminations are automatically added together, and may be measured simultaneously.

Sir William Preece's idea was to measure the illumination on the ground; and all his early work on street lighting was so done, and a good deal might be said for it. But some people think that the plane should be at 3 or 4 feet from the ground, approximating to the mean height of objects. Such a height allows a larger choice of photometers; for in some cases the observer is obliged to look through an eye-piece. It is a mistake to set the instrument up too high, for it begins to approach the lamps too closely. This has the effect of increasing the measured illumination in the neighbourhood of the lamp; but at a distance from a lamp-post greater than one-and-a-half times its height the difference is not appreciable.

Horizontal, Vertical, or Direct Ray Measurements.

The aspect of the plane on which the illumination should be received has been discussed by several writers. Some claim that it should face the lamp, as in candle-power measurement; others that the plane should be vertical. There is something to be said for each of these. The difference between the illumination in the two cases is insignificant at a distance from the lamp-post greater than twice its height. The illumination on the vertical plane falls off in the neighbourhood of the lamp, and vanishes when it is brought immediately below it.

The two advantages of the horizontal plane are that (1) if the illumination on it is sufficient, that on the other planes must be better; and (2) the illuminations received from all neighbouring lights add themselves together and give one single quantity which may be measured by one single observation. The economy of time and saving of calculation is enormous. The photometric survey of a street may be carried out in much less time, and with equal accuracy, by making a few measurements of illumination on a horizontal plane than by making candle-power measurements. In the former case no calculations whatever are needed; all illumination photometers being direct-reading. Candle-power measurements entail calculations for each observation, and further calculations involving the use of tables of cosines are required to reduce candle-power measurements to illumination. It is probably the tediousness of this mathematical work, and the distrust of novel instruments, that produce a reluctance to accept illumination as a basis for street lighting.

Another objection to the horizontal plane measurement is that it takes account of reflected light from buildings. But reflected light from the sky is of greater importance. This must be reckoned with in accurate candle-power photometry by narrowing the field of view; and it is one of the reasons why illumination photometry must give place to candle-power measurements when the light is feeble. On the other hand, it is difficult to know how to deal with the field of view in the candle-power photometry of powerful lights if there is a trace of mist or dust. The direct light being obstructed, as much diffused light as possible should be included, so long as it all belongs to the light to be measured, and is all true, diffused light from the mist, and not reflected from buildings.

For these and other reasons a considerable majority of those who have given attention to this matter agree that the illumination received on a horizontal plane is the best measure of the lighting of a street. Whether this is directly observed with a suitable instrument, or calculated from several observations of illumination or of candle power, is of minor importance. It is probable that some of those who disagree with the proposal to measure the illumination directly on a horizontal plane have never used, or perhaps seen, a photometer for this work.

A photometer for use in a test-room may be graduated directly in candle power; but an instrument to be used in the streets, at various distances from the source of light, must be graduated in foot-candles. The reading, multiplied by the square of the distance in feet, gives the candle power.

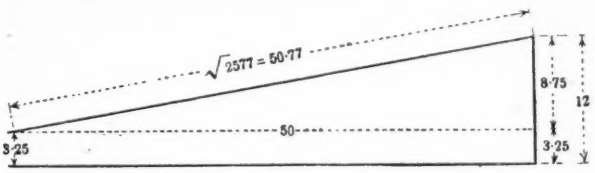


Fig. 1.

Take a case from the table in Appendix A—viz., a lamp 12 feet high, the photometer set up 3 ft. 3 in. from the ground, and 50 feet from the lamp-post. [See fig. 1.] As we do not want to know the actual distance of the lamp from the photometer, but the square of that distance, we take $(12 - 3{\cdot}25)^2 + 50^2 = 2577$. Let the illumination measured on the photometer screen directly facing the light be 0·029 foot-candle, then the candle power of the lamp is $0{\cdot}029 \times 2577 = 75$. The illumination which would be received on a horizontal screen is less than 0·029 in the same proportion that the height of the lamp is less than the slant distance from the lamp to the screen. The slant distance—the square root of 2577—is 50·77. The ratio 8·75 : 50·77 is 0·1725; and this, multiplied by 0·029, is 0·005—the illumination required. Or the angle of incidence may be calculated or measured. It is easier to measure it to 1° than to level the photometer to that accuracy. To calculate it, find the tangent. This is the ratio of the horizontal distance to the height; $50/8{\cdot}75 = 5{\cdot}71$. The angle is about 80°; and the tables give the cosine 0·1725—the ratio required. Another lamp 50 feet away doubles the illumination; making 0·01, for which the table is calculated.

This is a case in which the illumination on the horizontal plane would be difficult to measure with some photometers if there were only one lamp, on account of the feeble illumination 0·005 and the large angle of incidence. An error of 1° makes 10 per cent. difference at this angle. But when the illumination received at the midway point from the two lamps is measured, the reading 0·01 should give no difficulty; and a slight inclination of the photometer towards one lamp is balanced by its inclination away from the other. Some calculation is needed to find the candle power, more is required to deduce the illumination from it; but none whatever is necessary if the illumination is measured directly on a horizontal screen.

Average or Maximum and Minimum?

Assuming, then, that for the higher classes of street lighting the illumination received on a horizontal plane 3 ft. 3 in. above the ground is to be the basis of the estimation of the lighting, we have to consider how this has to be treated. In all these classes, some attempt is made towards uniform distribution. The mean value suggests itself as the one to be considered; but if this is investigated, it will be found to involve a great amount of calculation. It is easy to go wrong in this.

While the theoretical consideration of the mean illumination is intricate, the photometric observations necessary to yield a fair average would be very numerous, and would, in fact, amount to a photometric survey of the street. Fortunately, a little consideration shows that, while the mean illumination of a street may be up to a reasonable standard, it may have alternations of dazzling brilliance and dismal darkness. This proposal may, therefore, be discarded. Some have suggested that the average between the best and worst parts should be taken; but the area of the former always exceeds that of the latter, and the ratios in practice extend over such wide limits that this comparison will not serve.

The most satisfactory test appears to be the simple minimum illumination. Any excess of light may be regarded as a voluntary benefaction from the lighting authority or an unavoidable concession by the contractor. Neither party is likely to be too generous in this matter; but the draft specification provides that the height at which it is proposed to place the centre of light of each type of unit above the street surface is to be stated in the schedule to the tender. This gives the lighting authority an opportunity to control excessive light.

Report of the Surveyor Members.

The preliminary memorandum, to which reference has been made, stated that an illumination basis would necessitate the grading of thoroughfares into (say) special; first class, for main

thoroughfares; second class, for minor thoroughfares; and third class, for country districts or pilot lighting. At an early stage of the work of the Joint Committee, it was recognized that some such classification was essential, and that they must have practical data to work upon; and copies of street-lighting tests were supplied by Mr. A. A. Voysey, Mr. F. Bailey, Mr. F. W. Goodenough, Mr. Haydn T. Harrison, and Professor J. T. Morris. [See reference letters F_1 to N_1 on fig. 2.]

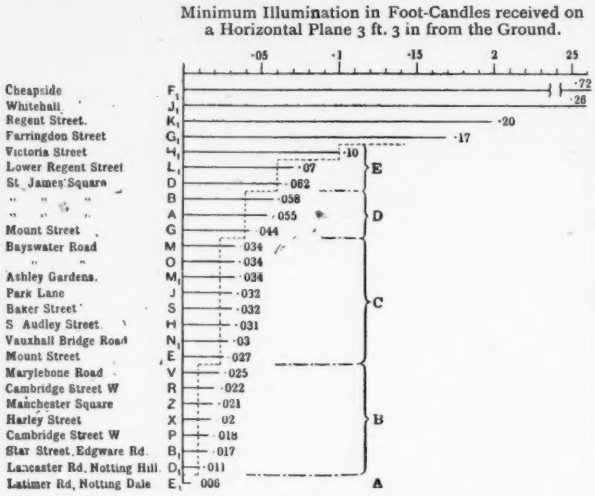

Minimum Illumination in Foot-Candles received on a Horizontal Plane 3 ft. 3 in from the Ground.
·05
·1
·15
2
25
Cheapside F1 ·72
Whitehall J1 ·26
Regent Street. K1 ·20
Farringdon Street G1 ·17
Victoria Street H1 ·10
Lower Regent Street L1 ·07 E
St. James' Square D ·062
" " " B ·058
" " " A ·055 D
Mount Street G ·044
Bayswater Road M ·034
" " O ·034
Ashley Gardens. M1 ·034
Park Lane J ·032
Baker Street S ·032 C
S. Audley Street. H ·031
Vauxhall Bridge Road N1 ·03
Mount Street E ·027
Marylebone Road V ·025
Cambridge Street W R ·022
Manchester Square Z ·021
Harley Street X ·02 B
Cambridge Street W P ·018
Star Street, Edgware Rd. B1 ·017
Lancaster Rd, Notting Hill. D1 ·011
Latimer Rd, Notting Dale E1 ·006
A

Fig. 2.—Results of Photometric Measurements.

By inadvertence, the class letters are not the same as those suggested in the specification. A represents the lowest class—viz., the minimum below 0·01 foot-candle. B is from 0·01 to 0·025. C is from 0·025 to 0·04. D is from 0·04 to 0·06. E is from 0·06 to 0·1.

After these tests had been considered by the Committee, the question of classifying them was discussed, and the surveyor members were asked to visit some streets for the purpose of judging what kind of classification would be possible. The four delegates of the Institution of Municipal and County Engineers (Mr. G. F. Carter, Mr. T. W. A. Hayward, Mr. E. B. B. Newton, and Mr. N. Scorgie) met on the evening of the 22nd of May, visited numerous streets in the Cities of London and Westminster, and the boroughs of St. Pancras, Marylebone, Paddington, Kensington, Holborn, Finsbury, Islington, Hackney, and Shoreditch. Their report is of value in itself, owing to the practical experience of these delegates and to the wide area examined by them; but additional interest is added by a confirmation of their estimates, which will be referred to later.

In the first place, they excluded the lighting of such streets as Whitehall, Regent Street, Cheapside, Cannon Street, Oxford Street, and others, because they are thoroughfares of a special character, and the lighting is more than is usually necessary for ordinary traffic. They thought that for any public lighting purposes streets might be grouped under three headings: (*a*) First-rate main lines of thoroughfare; (*b*) auxiliary roads and relief main roads; (*c*) side and unimportant streets.

Under (*a*) it was thought might be grouped such roads as Rochester Row, S.W., Ashley Gardens, S.W., St. James's Square, S.W., Portman Square, Baker Street, St. Marylebone Road, Park Road, St. John's Wood Road, Maida Vale near Elgin Avenue, and Bayswater Road near Victoria Gate. Under (*b*) it was thought might be grouped such roads as Vincent Square, S.W., Manchester Street, Harley Street (this was regarded as a rather superior amount of lighting for a class (*b*) street), and Cambridge Street. Under (*c*) they included such roads as Buckingham Road, Culford Road, and Sandringham Road, Hackney, and the main roads across the Park from Victoria Gate to Albert Gate. More names of streets could have been given; but the surveyors were of opinion that those selected, which include examples of both gas and electric lighting, were reasonably indicative of the standards.

It appeared desirable that this purely qualitative classification should be checked by quantitative measurements; and Mr. K. Edgcumbe, Professor J. T. Morris, and the author undertook to make a series of tests on the basis suggested by the draft specification—viz., the minimum illumination on a horizontal plane 3 ft. 3 in. from the ground, as well as the maximum illumination. In order to secure a long working evening, the test was made on Oct. 26, 1911. About 88 photometric measurements were made, besides measurements of distance and angle, at 31 places. There was no moon, and little, if any, reflection from wet streets. From two to six readings were taken at each place; the mean of each set is given. The readings agreed fairly well together—*e.g.*, Baker Street, 0·043, 0·046, J.T.M.; 0·045, K.E.; 0·046, A.P.T. Higher accuracy was not sought for, since the variations between the readings were much less than those between the neighbouring lamps or between successive measurements of the same lamp, due to the flickering wind. A Trotter photometer was used. No difficulty was found in comparing lamps of different colours.

The work began in St. James's Square at about 7 p.m. The minimum places were easily found, and a second photometer (carried in the hand) showed that for a distance of 6 or 8 feet in any direction from the spot chosen there was no appreciable difference in the illumination. Five or six lamps contributed to the illumination; and there was little difficulty in finding a position in which the observer's body did not cast a shadow on the photometer. The lighting of South Audley Street was so similar to that of Mount Street that only one set of measurements was taken. The highest maximum was found in Bayswater Road near Victoria Gate (2·28 foot-candles), and this was 67 times the minimum; giving a larger ratio than in any other street measured on that evening. But the street, having the Park on one side and gardens on the other, receiving no reflected light from houses, was lighted well and sufficiently for its important traffic; the minimum (0·034) being a good one. The ratio of maximum to minimum in Harley Street was 18, being less than in any other of the streets measured. Park Lane ranks next in this respect with a ratio of 19.

The results of these photometric tests, which are set out in full in Table I. and (together with others already referred to) in fig. 2,

TABLE I.—*Measurements of Maximum and Minimum Street Illumination.*

—	Class in Surveyors' Report.	Street.	Description or Nearest House.	Illumination on a Horizontal Plane 3 ft. 3 in. from the Ground. Foot-candles.		Max./min.	Distance of Maximum from Lamp-post.	Angle of Incidence.
				Minimum.	Maximum.			
A	(*a*)	St. James' Square	Middle of road opposite English and Scottish Law Life Office	·055				
B		"	Middle of road opposite London County and Westminster Bank	·058	1·86	32	5 ft. N.E. of lamp	
C		"	Lamp opposite Charles Street					
D		(7.25 p.m.)	Middle of road, N.E. corner of square	·062				
E	(*a*)	Mount Street	No. 97	·027	0·86	24	13 feet	
F		"	No. 15					
G		"	No. 103	·044				
H	(*a*)	S. Audley Street	No. 33	·031				
J	(*a*)	Park Lane	Opposite garden of Grosvenor House, W.	·032				
K		(8 p.m.)	" " " E.		0·60	19	19 ft. 6 in. S.	46°
L	(*a*)	Bayswater Road	First lamp E. of Victoria Gate, S. side of road		2·28	67	5 feet	33°
M		(9.45 p.m.)	" " N. "	·034				
N		"	Second lamp " N. "		1·79	53	5 ft. 10 in.	30°
O		"	" " " S. "	·034				
P	(*b*)	Cambridge Street	No. 43 N. "	·018				
Q		"	No. 47 N. "		0·63	31	5 feet	32½°
R		"	No. 13 N. "	·022				
S	(*a*)	Baker Street	No. 13 E. "	·032				
T		"	No. 73 W. "		1·24	18	4 ft. 5 in.	30°
U		"	No. 11 E. "		0·68		5 ft. 6 in.	32°
V	(*a*)	Marylebone Road	Middle of Madame Tussaud's N.	·025				
W			" "		0·60	24	6 ft. 6 in.	35°
X	(*b*)	Harley Street	No. 130 E.	·020				
Y		"	No. 126		0·37	18	5 ft. 5 in.	31°
Z		Manchester Square	No. 13 S.W. corner	·021				
A_1		Lower Berkley Street	Corner of Manchester Square		0·54	26	6 ft. 8 in.	36½°
B_1		Star Street, Edgware Road	No. 78 S.	·017				
C_1		(11.40 p.m.)	St. Michael's School N.		0·83	49	4 ft. 3 in.	26°
D_1		Lancaster Road, Notting Hill	No. 19	·011				
E_1		"	Nos. 14-15		0·53	48	4 ft. 3 in.	24°
F_1		Latimer Road, Notting Dale	No. 31 W.	·006				

are rather remarkable when they are compared with the report of the surveyor members. It shows they so accurately classified the streets by eye that, when the measurements of minima are arranged in order, they fall exactly in the classes. The class (*a*) has an illumination on a horizontal plane 3 ft. 3 in. from the ground not less than 0·025 foot-candle. The minimum illumination in class (*b*) varies from 0·025 to 0·015, and in class (*c*) it falls below 0·015 foot-candle.

This agreement is noteworthy. It shows that the judgment by eye by experienced men is in accordance with careful photometric tests; that photometric tests of illumination are not mere scientific experiments, but confirm quantitatively in definite figures the judgment of the eye; and, lastly, that the surveyor members seemed to have been unconsciously influenced by the minimum illumination in each case, for the maximum illuminations show no sort of agreement. Another result of these tests is to show that the ratio of maximum to minimum illumination is not a matter of importance; and it was agreed by the Committee that this point, which had appeared in the first preliminary draft, should be dropped. If the measurements had been made at the centre of the road, they would have been slightly higher, because the minimum places were not always in the middle of the street.

The Classification.

On discussing the proposed classification, there appeared, at first, to be a difficulty in dealing with those cases of brilliant street lighting which were not included in the report by the surveyor members. It is clearly a mistake to call it better than first class, for it is necessitated by dense and fast traffic in important thoroughfares. It was decided to invert the order, and to begin with the most extensive, and therefore very important, class, in which the minimum is below 0·01 foot-candle, which will be measured by taking the candle power of the lamps. This class was not designated. The other classes are as follows:—

A.—Minimum at least	0·01	foot-candle	
B.	,,	,, 0·025	,,
C.	,,	,, 0·04	,,
D.	,,	,, 0·06	,,
E.	,,	,, 0·1	,,

This leaves some twenty letters available for such higher classes of illumination as the progress of civilization may call for—classes which electric light and gas engineers will be happy to provide when invited.

The table in the appendix was originally calculated by Mr. Haydn T. Harrison to show the candle power required to produce a minimum illumination of 0·01 foot-candle on a horizontal plane 3 feet from the ground, midway between two lamps of given height and distance apart.* The column D gives the distance apart, the columns I the candle power, and the columns θ the angle which the ray makes with the horizontal. The lamps are supposed to give equal candle power in all directions. The top right-hand and the bottom left-hand corners of the table represent extreme and unpractical conditions. The figures between the stepped lines represent cases of ordinary practice; but they are not intended to suggest limits. The table shows the economy of placing the lamps as high as possible, subject to practical considerations. Tall lamps in a narrow street waste much light on the walls of the houses.

Final Work of the Committee.

When the Committee had reached this stage, they were asked to consider a draft specification which, while incorporating some of the principles on which the majority seemed to be agreed, directed that the surveyor should fix the position and height of all lamps, and adjudicate on refracting lenses and reflectors. It was suggested that candle power should be measured at two angles—20° and 50° with the horizontal. This was fully discussed at several meetings, and attempts were made to reconcile or to amalgamate the two somewhat different drafts.

A good deal of consideration was given to conditions of contract, and to a form of tender; and a specification for details of the suspension of lamps over streets was discussed. It was felt that, while these matters are of great importance, and that the suggestions coming from experienced engineers would be of high value, they were rather beyond the scope of the Joint Committee at the present stage. Some disappointment was felt about this limitation of the draft specification; but it was finally agreed that circumstances differ so widely in different cities and towns, both as regards the procedure and constitution of lighting authorities and the requirements of the streets, that it would be better to put forward a draft of "Standard Clauses for Inclusion in a Specification of Street Lighting."

These clauses form Appendix A. They were submitted to their Councils by the delegates of the four Institutions. They were accepted by the Council of the Institution of Electrical Engineers, who authorized the embodiment of the specification and appendices, and of the material collected by the Committee, in the present paper. The Council of the Institution of Municipal and County Engineers suggested some useful drafting amendments which have been incorporated in the clauses as printed. The Council of the Illuminating Engineering Society accepted the clauses as a draft and tentative specification, and recommended that a supplementary specification should be added, defining the conditions to be complied with by an instrument for testing illumination or candle power in the street. This specification has been prepared by the Illuminating Engineering Society, and forms Appendix B. The Institution of Gas Engineers, while fully appreciating the valuable work which had been done, regretted that they could not agree with the fundamental basis of the suggested specification—viz., the stipulation of illumination with a stated foot-candle minimum measured on the horizontal plane.

In these circumstances, the Joint Committee were reluctant to take any further steps until an attempt had been made to review the problem and give an opportunity for a full debate upon it. Meantime, the author had been invited to contribute a paper before the Illuminating Engineering Society dealing with some aspects of street lighting. It occurred to the Council that the platform of the Illuminating Engineering Society might be utilized for an open discussion on the tentative specification prepared at a joint meeting of the four bodies interested. This proposal met with the unanimous approval of the Joint Committee. The delegates of the Committee accordingly recommended to the Councils of their respective Institutions that they should fall in with this suggestion, and sanction the use in this paper of the material brought before the Committee. The present paper is the result. The author has endeavoured to state in precise terms the chief objections to the basis of the proposed clauses, and to defend them in a manner which he hopes will conduce to the development of illuminating engineering.

APPENDIX A.

DRAFT STANDARD CLAUSES FOR INCLUSION IN SPECIFICATION FOR STREET LIGHTING.

Intent of Tender.

1.—The form of tender headed "Lighting of" includes the provision, fixing, connection, and maintenance of all lamps necessary for obtaining the illumination specified as Class....in and according to the conditions of the standard specification.

Unit of Measurement.

2.—This specification is based on illumination; the unit of measurement being one foot-candle.

Classification of Street.

3.—For convenient reference, the streets are classified as having a minimum illumination as follows:—

Class A	. . . . .	0·01 foot-candle.
,, B	. . . . .	0·025 ,,
,, C	. . . . .	0·04 ,,
,, D	. . . . .	0·06 ,,
,, E	. . . . .	0·10 ,,

Street lighting at a lower illumination than 0·01-candle power may be specified by the height and distance apart of the lighting units, and the candle power as measured in the direction of the thoroughfare at an angle of 10° below the horizontal.

Minimum Illumination.

4.—The "minimum illumination" of a street means the minimum illumination on a horizontal plane at a height of 3 ft. 3 in. above the ground-level, and may be measured by means of—

(*a*) Any suitable illumination photometer, or

(*b*) Any suitable photometer adapted for use in the street which will measure the candle power of the lamps in those directions which meet at the point of minimum illumination. In this case the minimum illumination will be calculated by adding together the values of the illumination received from each lamp that materially contributes to the result. In this connection, a useful table will be found in this appendix.

Special Illumination.

5.—The special illumination of certain points indicated on the map, such as the corners of cross streets, may be dealt with by specifying the positions and height of lamps and illumination at those points.

Type of Photometer.

6.—The photometer shall be of the.....type, or of such other type as may be agreed between the parties.

Position of Lighting Units.

7.—The approximate positions of the lighting units are indicated on the accompanying map, and are correct within the limits of deviation marked thereon. The contractor shall indicate the positions of all the lighting units, either by completing the said map or by a descriptive schedule accompanying his tender.

Particulars of Lighting Units.

8.—Detailed particulars of each type of lighting unit included in the tender must be inserted in the space provided for that purpose in the specification, and must include a statement of the height at which it is proposed to place the centre of light of each type of unit above the street surface, subject to a declared minimum.

Drawings.

9.—Drawings of all details as required by the specification shall accompany the tender.

Samples.

10.—Samples shall be submitted, if required, before the acceptance of the tender.

Number of Lighting Units.

11.—The number of each type of lighting unit required must be inserted in the tender, with, if called for, a quotation for the provision,

* The table has been recalculated by Mr. M. Wilson, of the Board of Trade. In re-calculating the height, 3·28 was used instead of 3·25, thus approximating more closely to the metre. The difference in the result—less than half of 1 per cent.—is, of course, inappreciable. [Note by author.]

TABLE *prepared by Mr. Haydn T. Harrison, giving the Candle Power necessary to Produce a Minimum Illumination of* 0·01 *Foot-Candle on a Horizontal Plane* 3 *ft.* $3\frac{3}{8}$ *in. above the Ground.*

[D is the distance apart of the lamps; θ, the angle which the ray makes with the horizontal; I, the illuminating power.]

	10 Feet.		12 Feet.		14 Feet.		17 Feet.		20 Feet.		24 Feet.		30 Feet.		36 Feet.		
D	θ	I	θ	I	θ	I	θ	I	θ	I	θ	I	θ	I	θ	I	D
50	15	12·9	19	10·6	24	9·4	29	8·5	34	8·1	40	8·3	47	9 2	53	10·7	50
54	14	16·0	18	13·1	23	11·4	27	10·1	32	9·6	38	9·5	45	10·3	50	11·7	54
56	13	17·8	15	14·5	22	12·6	26	11·0	31	10·4	37	10·2	44	10·9	49	12·2	56
60	13	21·6	16	17·5	21	15·1	24	13·1	29	12·1	35	11·7	42	12·1	47	13·4	60
64	12	26·0	15	20·9	20	17·9	23	15·4	28	14·1	33	13·4	40	13·6	46	14·7	64
66	12	28·4	15	22·8	19	19·5	23	16·6	27	15·1	32	14·3	39	14·3	45	15·3	66
70	11	33·7	14	26·9	18	22·0	21	19·4	25	17·5	31	16·2	37	16·0	43	16·8	70
75	10	41·1	13	32·7	17	27·7	20	23·2	24	20·7	29	19·0	35	18·3	41	18·8	75
80	10	49·7	12	39·3	16	33·1	19	27·6	23	24·4	27	22·1	34	20·8	39	21·1	80
85	9	59·3	12	46·8	15	39·3	18	32·5	21	28·5	26	25·5	32	23 7	38	23·6	85
90	9	70·1	11	55·2	14	46·2	17	38·0	20	33·1	25	29·3	31	26·8	36	26·3	90
95	8	82·1	10	64·6	14	53·8	16	44·0	19	38·2	23	33·6	29	30·3	34	29·3	95
100	8	95·5	10	75·0	13	62·4	15	58·0	18	43·8	22	38·3	28	34·1	33	32 6	100
110	7	126·6	9	99·0	12	82·1	14	66·4	17	56 8	21	49·0	26	42·8	31	40·0	110
120	6	163·7	8	127·8	11	105·6	13	85·0	16	72·3	19	61·7	24	53·0	29	48·8	120
130	6	207·6	8	161·7	10	133·3	12	106·8	14	90·4	18	76·6	22	65·0	27	58·9	130
140	5	258·7	7	201·3	9	165·6	11	132·3	13	111·5	16	93·9	21	78·7	25	70·5	140
150	5	317 7	7	246·8	9	202·8	10	161·5	12	135·7	15	113·7	20	94·5	23	83·7	150
160	5	385·0	6	298·8	8	245·2	9	195	12	163·2	14	136·2	18	112·3	22	98·7	160
180	4	547·0	6	424	7	347	9	275	11	229	13	190	17	155	20	134·2	180
200	4	749	5	580	7	474	8	375	10	312	12	257	15	207	18	178	200
220	4	996	5	770	6	630	7	496	9	412	11	338	14	271	16	231	220
240	3	1292	4	999	5	815	7	642	8	532	10	436	13	348	15	294	240
270	3	1837	4	1420	5	1158	6	908	7	552	9	615	11	488	14	410	270
300	3	2519	3	1945	4	1586	5	1245	6	1028	8	338	10	662	12	553	300

fixing, and connection of the necessary apparatus, and the price per annum for maintenance and for....hours' lighting, on which the tender is based.

Additional Lighting Units.

12.—The contract will provide for additional lighting units if required, such increase not to exceed....per cent., and to be paid for at the quoted rate per lighting unit.

Tests.

13.—A test of the illumination shall be made under such normal atmospheric conditions as will not appreciably affect the accuracy of the result, and at a fairly selected point, not being in the shadow of a mantle, lamp, electrode, lantern bar, post, tree, or other obstruction. When a minimum illumination or candle power of lighting unit is specified, it shall be held that such minimum is obtained if the average of the measurements of any three minima between consecutive lighting units of the same type does not fall below it.

Contract to be Signed.

14.—The tender contains the usual clause that the provisions, conditions, and prices named therein shall form the basis of a contract containing the necessary legal provisions to ensure its fulfilment.

Heads of Clauses for Contract.

15.—The contract will also include provisions for—

(1) Ensuring the lighting of all lamps during fog, at prices to be quoted.

(2) Execution of work in such manner as may be necessary for the convenience and safety of the public.

(3) Indemnifying the council against claims arising out of the execution or maintenance of the work or failure of the lighting.

(4) Payment of moneys due for work done.

(5) Defining the responsibilities of the contractor, and to enforce the conditions of the specification and tender with due regard to practical difficulties.

The following clause is suggested as a guide: The intention of the contract is that during the maintenance guarantee period of a construction contract, and during the term of a lighting contract, the contractor shall assure himself that the lamps he provides are, during lighting hours, fulfilling in all respects the requirements of the contract; and he shall not claim relief from the conditions of the contract on the grounds of non-notification on the part of the council of any failure to comply with the terms of the contract.

SPECIAL CLAUSES.

1 —Each specification may contain special clauses to meet the needs of the particular locality.

Detail Prices.

2.—In cases where the specification only calls for the supply, delivery, erection, and connecting-up of the lamps, or any of these items, the following further details may be called for:

(*a*) The cost of the necessary fittings (excluding cost of renewable parts, such as lamps or mantles) delivered on site.

(*b*) The cost of erecting same.

(*c*) The cost of connecting the same to source of supply.

(*d*) The quantity of gas, oil, or electricity, required to maintain the degree of illumination specified, and the pressure at which such gas, oil, or electricity is to be supplied.

Detail Maintenance.

3.—It may also be necessary in some cases to call for the cost of maintenance divided-up under the following headings:

(1) Maintenance of all parts, such as posts, fixtures, or fittings, including cost of cleaning and painting at stated intervals.

(2) Maintenance of all renewable parts, such as mantles, lamps, or carbons, including labour connected therewith.

APPENDIX B.

DRAFT REQUIREMENTS FOR THE TESTING AND FOR THE USE OF A STREET PHOTOMETER.

A.—GENERAL REQUIREMENTS FOR ALL CLAUSES.

(1) *Division or Graduation.*—The instrument to be so made that it can be verified at any time for accuracy of graduation by direct test on a photometric bench with the light falling perpendicularly on the test-plate. This verification to be made at not less than 5 points on the scale; the error under laboratory conditions not to exceed + or — 3 per cent. at readings above 0·05 foot-candle.

(2) *Range.*—The scale shall include, either directly or by means of adjustments for various grades, a range from 0·003 to 3 foot-candles.

(3) *Constant.*—Before and after making a series of outdoor tests, the constant of the scale shall be verified at least at one point on the scale between 0·05 and 1 foot-candle against a sub-standard. If an electric accumulator is used, it shall have been run, after charging, for not less than 15 minutes.

(4) *The Lamp* shall be tested (together with the electric battery, if any, and any controlling resistance or measuring instruments) at about mid-point on the range for 15 minutes continuously, without showing any appreciable change.

(5) *The Angle of Incidence* (that is, the angle between the direction of the ray of light to be measured and the vertical) shall be measured to 2° by suitable means.

B.—REQUIREMENTS FOR A CANDLE-POWER PHOTOMETER.

(1) *Stray Light* from neighbouring lamps, buildings, and sky shall be excluded.

(2) The height of the test-screen from the ground is immaterial.

C.—REQUIREMENTS FOR AN ILLUMINATION PHOTOMETER.

(1) The test-plate, if forming part of the photometer, shall be so arranged that it may receive the sum of the illuminations of neighbouring lights without obstruction.

(2) The test-plate shall be free from polish or glaze, and the photometer shall be tested in a laboratory for variation from the cosine law. Up to the angle of incidence of 60°, this total variation shall not, under working conditions, exceed 10 per cent.

(3) Provision shall be made for holding horizontally, and at a height of 3 ft. 3 in. above the ground, the test-plate which receives the light to be measured.

DISCUSSION.

Mr. F. W. GOODENOUGH (the Chairman of the Council of the Society) mentioned that, as there were several gentlemen who wished to speak on the paper, and as it would be impossible to get through the discussion in the one evening, it had been determined to resume it on April 29. He asked Mr. Patchell to open the discussion.

Mr. W. H. PATCHELL (Chairman of the Joint Committee on the Standard Street Lighting Specification) said that though, at the last meeting of the Committee, they could not arrive at a definite conclusion, they came very near to one; and it was considered that, if they could get the matter aired on neutral ground, they would be able to educate people up to it. They had on the Committee Mr. Trotter, who had made this subject a hobby for some thirty years; and having obtained Mr. Trotter's consent to put the enormous amount of material they had collected into the form of a paper, they secured the sanction of the four Societies represented on the Committee to the matter being openly discussed on neutral ground. They ought to thank the Illuminating Engineering Society for the opportunity for doing this that they had afforded; and they ought to pass to Mr. Trotter a very hearty vote of thanks for the immense trouble he had taken in digesting and putting into

form the mass of information accumulated. They were almost led to believe that it was dangerous to bring gas and electricity together; but he did not think it was. He believed that both gas and electricity could be handled in a fashion which was perfectly safe, though there was a good deal of scare in the minds of some people that gas and electricity were dangerous. The matter before them was one which they could discuss so long as they met on neutral ground. In the work of the Committee, the most striking thing was the report of the surveyor members, and the way it was corroborated by the tests taken in the streets. Of course, it was all very well for a London man to say, "I want to light a street like the Strand, or Regent Street, or elsewhere;" but it was very difficult to translate the lighting of such thoroughfares to other streets. If the surveyors would be good enough to specify what they wanted in one of the three classes of streets mentioned, then they could comply with their requirements. The records of measurement taken by the illuminating engineers fell into marvellous accord with the views of the surveyors as represented in the paper. It showed that the surveyors knew their business absolutely—even better than they themselves realized. They knew exactly what they wanted; and they did not say that any one street was in a wrong class. But why could they not have some standard—some means of giving a description; so that a man (say) in Newcastle could be told how a certain street was lighted elsewhere? The paper pointed out the way. Before they went on, the Joint Committee thought it only right to get the opinion of the police on the subject of illumination, and to ascertain what motor drivers had to say in regard to it. He personally wrote to one of the leading members of the Royal Automobile Club. His reply was that the darkest streets suited his purpose best. So long as he was driving in a dark street or in the country he was happy; but when he came into the brightly lit street he was dazzled. This might be taken as a plea for the concealed lighting principle in streets. The gas or electricity industry would not object to it; but the public who had to foot the bill would. There was one report that they had had before the Committee to which Mr. Trotter had not referred. It was a report made by Professor Morris on a series of tests to show the agreement between illumination on a horizontal surface, and that calculated from direct illumination from several sources. The report brought out the difficulty of measuring very low illumination on the horizontal plane, because stray lighting affected it. Probably, during the discussion, they would hear more about this, because it was an interesting point. One of the objects of the paper was to put into the hands of those interested a great deal of the valuable information the Committee had collected, and so save people going over the same ground twice. He concluded by moving a hearty vote of thanks to Mr. Trotter for putting the matter before them in such an interesting fashion.

The CHAIRMAN said he should like to second the motion. As a Society interested in the problems of illumination, they were fortunate in having so skilled, and at the same time so independent, an authority on matters of photometry as Mr. Trotter, to lay a paper before them upon what was undoubtedly a controversial question. Mr. Trotter said the Society existed to study the development and use of artificial illuminants, and to raise the standard of artificial lighting in all directions in which it had to be used—in this particular instance, in street lighting. That was so; and as Mr. Trotter had indicated, and Mr. Patchell had remarked, the Society offered neutral ground for the discussion of these questions, quite irrespective of the agent used for producing the illumination. This was a point all should bear in mind in discussing the paper. As Mr. Patchell had said, the experience of several years had proved that gas and electricity could be brought into close proximity in that room without any explosion or fusing; and he (the Chairman) was quite sure this happy state of affairs would continue. What they were there that evening trying to get at was what would be a satisfactory specification whereby the public might be sure of obtaining the type of, and the result in, illumination which they desired. They had to discuss to what extent the draft specification put before them lent itself to this object, and whether any amendment of the specification would bring it nearer the ideal. He wished to reserve to himself the right to speak on the subject at a later stage in the discussion.

Mr. HAYDN HARRISON (London) said he should like to add a little to what had been said about the able way in which Mr. Trotter had prepared this most difficult paper. He had done what he (Mr. Harrison) thought very few other men could have done in a short paper like this; he had thoroughly grasped the situation. Early in the paper, the position was put into a nutshell when Mr. Trotter said: "It seems better that the lighting authorities should settle what it is they want to buy, and, having specified it, to leave details to the competitive skill and wide experience of contractors." He (Mr. Harrison) was not referring so much to the last words, as to the preceding ones, that local authorities should settle what it was they wished to buy. The main question in street lighting had never up to the present time been settled by the local authorities, and that was what they wanted to buy. It had never been settled by the representatives of the authorities—that was to say, their surveyors or their engineers—what it was they wanted to buy. The lighting authorities seemed to have got into a groove. They had a street, so many yards long, with so many lamp-posts in it; but whether the lamps gave anything in particular in regard to illumination had, up to the last little while, been a matter of no importance whatever. What the result of it all was had never been mentioned. Right at the beginning of the paper, Mr. Trotter referred to him, and said that the large amount of work that had been done in this direction by the members of the various societies was due to a paper that he (Mr. Harrison) read in 1910. He would like to point out that, in that paper, he reduced the results of the various examples of street lighting that he was talking about at the time to horizontal illumination; he also gave the direct illumination, and the candle power per lamp. The object of the specification was to reduce all these details—whether it be candle power per lamp, or direct or horizontal illumination—to an agreed basis. Mr. Trotter remarked that several members of the Committee raised objection to basing the specification on illumination, instead of candle power; and it was agreed that the author should prepare a statement supporting the first clause, and that he (Mr. Harrison) should prepare a statement of objection to it. He wanted a correction made. Mr. Trotter said that he (Mr. Harrison) had never absolutely objected to the basis of illumination. What he objected to was the basis of minimum illumination, because it was difficult to always measure it—the illumination in certain classes of street being so low that it could not be conveniently measured. There was a large percentage of streets where they could not, under open-air conditions, measure correctly the minimum horizontal illumination. Mr. Trotter mentioned in the paper that there were 80 per cent. of street-lamps the minimum horizontal illumination of which could not be conveniently measured. The Committee, therefore, decided to put the specification on the horizontal illumination basis, in the "A" streets, at 0·01 foot-candle; and beyond that they gave a clause which allowed the calculation of what the minimum illumination would be by measuring the candle power. That was the one point that he (Mr. Harrison) raised, that if the Committee had decided to specify horizontal illumination for the average street, it would, on account of its lowness, have been liable to error in measurement. Therefore they came to the conclusion that in any street in which they could not safely get a minimum horizontal illumination of 0·01 foot-candle, the basis should be a matter of measuring the candle power, provided that the measurement was made at an angle which would reach the point of minimum illumination. In other words, if they had lamps 10 feet high (which he thought was the usual practice not only in this country, but all over the world), the candle power of these lamps would be measured at an angle which would reach the point of minimum illumination, and then the minimum illumination could be calculated. The specification did, to his mind, deal in exactly the best way with the whole problem. Regarding the more highly illuminated streets, he realized that the lighting of all streets naturally would increase on account of the demands of increased speed of traffic, and he hoped on account of the demands of the population served. Mr. Trotter himself gave the present criterion of public lighting in one of the clauses of his paper, when he said that at the present time the lighting of the streets actually depended upon how much money could be taken from the rates for the purpose. He did not say it was so in London, where "A" streets existed, and the rate for street lighting did not represent anything really important; but in the country streets the money that was available for the purpose of street lighting very largely indeed governed the character of the lighting that was carried out. But if this specification became general, nearly everybody could say: "I have £300 per mile to spend on illuminating such class of street, and I have £100 per mile to spend on illuminating another class of street." If this specification were used with intelligence, absolutely the best possible lighting would be obtained for the money expended. A man would not utilize the money allowed for the purpose by saying: "I have £200 to spend. I will put up ten £20 lamps." He would look at the table at the end of the paper; and he would find that ten lamps at £20 would not give him such a good horizontal illumination as if he used fifty lamps (say) at £4 each. This was a point that he hoped everybody would appreciate when he read the paper. Mr. Patchell had said that a motorist friend of his had stated that he would prefer streets without any light at all. That man would never have said so if he had been driving in streets in which small candle-power lamps were spaced 50 feet apart, showing the line of the kerb and the people on the pavement; that would be ideal lighting for the motorist. But the motorist did not like to pass from extreme darkness into extreme light. The horizontal minimum specification got over this difficulty right away, because it said that one must not, according to the specification, illuminate the road or street below a certain point. As Mr. Trotter so well put it in the paper, the question as to the extent to which they might go in extreme illumination in the upper direction, was not mentioned. This was not a serious objection, because in high-class streets, with the minimum illumination at 0·01 foot-candle, they were not likely to run higher than 5 foot-candles. But what did matter was the badly lighted street where they got below 0·01 foot-candle and as high as 5 foot-candles. That was what the motorist objected to. As to any other possible means of drafting a specification for street lighting, they were not in this country the first people to deal with the question of street-lighting. It had been dealt with in other countries on much the same lines—horizontal illumination at a specific height above the ground. What should be the height above the ground had been treated upon in Messrs. Pearce and Ratcliff's recent paper. The specification mentioned the "metre," which showed that the subject had been dealt with outside this country. The metre height was a most convenient one at which to work. The second

reason why this height had been chosen was because it happened to be half way between the ground level and the objects they wanted to illuminate. It also illuminated the faces of pedestrians. The best object of all, which had never been stated yet, was this, that if any lighting authority got a satisfactory illumination at a metre above the ground, he was going to get a more satisfactory illumination on the ground. If they got 0·01 foot-candle at 1 metre above the ground with an average height of post, they would probably get 0·02 foot-candle at the ground-level, which was a satisfactory illumination for all purposes. As he had already said, he was put up to deal with this matter, as he had been in the habit of measuring candle power; and the reason he had taken the line he had was that at least 90 per cent. of his measurements had had to be carried out where the candle power of lamps had not exceeded 50. To measure 50-candle power at (say) 100 feet away was to encourage inaccuracies. He preferred to measure the 50-candle power lamp at 20 feet from it, and measure the ray which he thought would reach 100 feet. That particular means of measuring was still allowed by this specification; and therefore it presented no difficulty whatever. Those used to judging street lighting—surveyors, for instance—were equally able to carry out the specification. Although he knew that a member of the Joint Committee had no right to congratulate the Committee upon having provided a specification that filled a useful want, he could not help thinking that it would be extremely difficult for any Society connected with this particular work of street illumination, in this or any other country, to much improve on this specification. He said this after twelve to fifteen years' solid experience in street lighting work.

Mr. Robert Watson (Doncaster) said he should first like to express his thanks to the Council of the Illuminating Engineering Society for the invitation they had extended to him to take part in the discussion of what was a very interesting topic—that of street illumination—on what had been described that evening as neutral ground, and also for the opportunity of meeting friends who were engaged in the same work though in a different and competitive phase of it. While it must be acknowledged that some very good work had been done by the Joint Committee, and in many respects useful clauses drawn up, they had not all seen eye to eye as to the method in which street illumination should be appraised. The fundamental basis of the specification now drafted was that street lighting should be judged by the minimum illumination obtained at any point in the street—that point being usually midway between the lamps; and that this illumination, expressed in foot-candles, should be measured or computed as received on a test-screen placed horizontally at a height of 3 ft. 3 in. above the ground-level. Although there were some lighting authorities who favoured the appraisement of street lamps by their polar distribution of candle power, no great objection had been raised in the Joint Committee to either street-tests of the illumination which (as Mr. Trotter said) a municipality was out to buy, or to the acceptation of the minimum illumination as the basis, with 1 foot-candle as the unit. When, however, they came to the question as to the method in which that minimum illumination was to be computed, differences of opinion among them were at once apparent. The draft specification clearly proposed that street illumination should only be appraised by measuring or computing the illumination in foot-candles on a horizontal plane; and that all results should be expressed in horizontal-plane foot-candles. It was with this stipulation that some of the members of the Committee felt bound to disagree. Those of them representing the Institution of Gas Engineers, and at least one municipal representative, did not consider that the computation and expression of illumination values in horizontal foot-candles afforded any true guide to the actual illumination received and used by the people—pedestrians, drivers, and others—in the street. Nor did they consider that these values equitably represented the comparative merits of lamps of different polar distribution, or of different heights and location. Unhappily, the representation of the Institution of Gas Engineers—two or three only out of a large Committee—was numerically very small, compared with that of the electrical industry, whose practice, due to certain causes, had always been to use horizontal plane measurements. The views in this respect of those representing the gas engineering profession were not, therefore, reflected in the draft standard clauses. His own opinion was strongly that the illumination actually and chiefly employed in streets, and which, therefore, municipalities were, or should be, "out to buy," was of the direct-ray character, and that, therefore, the candle power of any lamp, or its direct-ray foot-candle equivalent at the point of minimum illumination was of the greater importance. For the purpose of seeing, recognizing, or avoiding collision with other people or vehicles, or houses, walls, and the like, they used the direct light which was falling upon them. Even when a person was approaching from a lamp, his figure was silhouetted against the direct light from the light source behind him; and contact with him was avoided because of that fact. This was surely the case with motor or other vehicle drivers, who rarely looked on the ground—being more concerned with what was immediately in front of them. They did not particularly interest themselves with the ground illumination, still less with horizontal plane illumination at a height of 3 to 4 feet above the ground. Superintendent Bassom, of the Public Carriage Department of Scotland Yard, on his attendance at one of the meetings of the Joint Committee, stated that cross traffic at street junctions always required great consideration. One could not conceive of anything but direct light being of service to a driver if he wished to avoid collision in such a case. Under ordinary street conditions, one rarely looked upon the ground, and even if one did, it was a question whether less use was not made of the horizontal plane illumination from several lamps than the light from the lamps in front shining on the ground, and being reflected in direct rays to the eyes. The purpose of illumination in streets was quite unlike that in halls or rooms where reading, writing, or work was in question, and where the diffused light from ceilings and walls constituted an important factor. Apart from the views that the horizontal plane method of appraisement did not apply to the chief uses of street illumination, it had been admitted by Mr. Trotter that with 80 per cent. of the lighting of the country, it could not be used at all. The reason was that, in some streets and roads, the lamps were too widely spaced to permit of accurate minimum horizontal illumination tests; and in the majority of provincial streets this would, he (the speaker) was afraid, be long the case, since the funds of the municipalities would not allow them to be as liberal as they would like in public lighting. In these cases—80 per cent. of the whole—candle-power measurements were in accordance with the specification to be adopted. In other words, the appraisement and expression of the illumination obtained were to be virtually in direct foot-candle values. Hence the desired uniformity and standardization of illumination methods of computation were as far away as ever. In the meantime, the specification legislated for only 20 per cent. of the lighting of the country, and demanded computation by methods as to which there was still some fair diversity of opinion—not only here, but also in America and on the Continent. In America, lighting authorities, both gas and electric, believed in the appraisement of street illumination on the basis of the light received on a screen placed perpendicular to the light-ray. The German Association of Gas Engineers, according to Professor Strache, did not even believe in the specification of minimum illumination, and were in favour of the stipulation of candle power for contracting purposes. The replies received to the queries advanced by the "Illuminating Engineer" some time back were various, and to some extent conflicting. Four or five of the eleven replies were against street tests altogether. A number of replies (principally from the electrical industry) dealing with horizontal plane methods of computation wanted either confirmatory laboratory tests, or tests of the vertical illumination, apparently considering the latter of importance. In other cases, a statement of the maximum and mean, as well as the minimum, illumination was required. The latter was the case of the German Electrical Association, whose conclusions were derived from a comparison of two systems of testing only—the horizontal and vertical plane (not direct-ray) methods. The vertical plane under a lamp had some of the defects of the horizontal plane used at a distance from the lamp. Dealing with another phase of the subject, he and those associated with him did not consider that the horizontal plane computation of illumination values was a fair and impartial method of appraisement, since equal justice could not be done, nor unfair penalization avoided, in the case of lamps of different polar distribution, and with different heights and locations. It might, for instance, be deemed advisable in many cases to use closely-spaced lamps of moderate height in order to ensure getting well-distributed and diffused illumination. By direct-ray testing, evidence of the value of such a scheme would be obtained; but by the horizontal plane method, with the test-screen not much lower than the light source, the light would, by reason of its obliquity, give very low readings. On the other hand, a light source raised to a greater height, while not giving the particular illumination desired, would yield higher figures, because the light rays coming from above were virtually approximating to the direct-ray character. In speaking of lamps of moderate height, low lamps were not necessarily meant, so that the question of glare (if any) need not be considered. Lamps used for good illumination were not less than 15 or 16 feet high (not 10 feet as stated by Mr. Harrison), and were, therefore, sufficiently high above the line of vision. Apart from this, however, Superintendent Bassom, of Scotland Yard, told the Joint Committee that he did not think that glare in itself was the cause of accidents, although sometimes given as an excuse. It was interesting to note that, with regard to horizontal plane testing, if, starting from a midway point between two lamps, the test-screen was traversed towards one of the lamps, the rays became more and more direct, and therefore less affected by the cosine law. Hence in the vicinity of the lamps there was little difference between horizontal and direct-ray readings, although the values at the midway point were altogether different, which seemed certainly to suggest that the horizontal method was inconsistent. This was borne out by, and accounted for, the large diversity factors disclosed by tests made in this way. Table I. in Mr. Trotter's paper showed one as high as 67—a diversity of which the eye was not conscious, because, as he believed, it used direct rather than horizontal plane illumination. If two curves of horizontal plane and direct-ray illumination obtained between two lamps were plotted out, and contrasted, the diversity differences were clearly shown; and he would give, as an example, a test of two lamps each yielding (say) 1000-candle power where at the midway point the combined horizontal plane illumination was 0·086, and the diversity factor 25, whereas the single minimum direct-ray reading was 0·181 and the diversity factor in this case 15. One was inclined to think that the latter more nearly accorded with ocular experience, and therefore suggested that direct-ray illumination was principally used. Even if the horizontal plane test of illumination were generally accepted, there would appear to be among its advocates differences of opinion

as to its application. The "Electrician" of the 14th ult., commenting on the Manchester tests, and most probably reflecting the views of many of its readers, saw no reason for the specification of any height for the test screen—considering it more sensible to take the street level. The "leader" remarked that horizontal illumination was required for seeing obstructions on the street surface—not objects 3 ft. 3 in. above the surface; and that it was vertical illumination that was required for discriminating objects at a height, such as house numbers, &c. (and the "etcetera" might certainly be taken to include vehicles and people). It was a startling fact that, in a recent comparison of two systems of lighting in the streets of Manchester, they had the testimony of several gentlemen representing various interests agreeing that, as far as the eye could judge, the illumination in the one case was as good as the other; and street photometer tests of the horizontal plane illumination were required to suggest any difference. To his mind, had the tests been made of direct-ray light, the photometer values would have been more in accordance with those of the eye. In other words, if the observers were lying on their backs, their eyes occupying the position of the horizontal screen, they would only then become conscious of the differences produced by the street photometer. So far as reflection effects were concerned, the direct-ray instrument in which the comparison screens could be placed side by side was more likely to yield true results than the horizontal plane photometer, where one screen was on the outside, and the other inside the box. In connection with the effect of extraneous light in street tests generally, he should like to refer to some tests that had been made for the Joint Committee. Professor Morris was good enough to furnish data making comparisons in one case between (*a*) the measurement of illumination from several lamps on to a horizontal plane test screen (equal to 0·0188 foot-candle), and (*b*) the measurements of the direct light received from each of the several lamps, and subsequently corrected to the horizontal basis, and added together (equal to 0·0147 foot-candle). It was interesting to note that the latter differed from the former by 22 per cent. In view of the fact that it was admitted that direct-ray tests were less affected by the reflected light than were horizontal plane tests, Professor Morris's experiment suggested how difficult it was to get comparable and fair data with a horizontal plane test screen. One member of the Committee had made experiments with the Trotter photometer, using first the illumination received at right angles in the usual way, and then in the same way with a 10 in. by 1½ in. tube attachment, in order to get the net illumination. His tests showed at

	Total.					Ft. c.	Per Cent.
75 ft. distance	0·6	ft. c.,	of which the stray illumination was			0·01	= 1·6
150 ,, ,,	0·14	,,	,,	,,	,,	0·008	= 5·7
300 ,, ,,	0·14	,,	,,	,,	,,	0·005	= 3·5

While these figures showed that stray light had an effect, they also proved that an instrument could be made to eliminate adventitious illumination. The member in question was satisfied as to the accuracy of his tests, as he said that up to 300 feet the candle powers checked very satisfactorily.

75 ft. = 3300 c.p. 150 ft. = 3100 c.p. 300 yds. = 3200 c.p.

A further advantage was the fact that the higher readings of the direct-ray instrument tended towards accuracy of result, and to lessen the possible errors in connection with colour troubles. One point in particular should be mentioned—that of the disadvantage of appraising street illumination by values such as those of the horizontal-plane method which ran or might run into small figures. In view of the admitted possibility of errors due to the personal equation, the instrument, and its usage, the higher the values the better. Otherwise, contracts would have to provide for a sufficiently large margin between the actual and the expected minimum street illumination before fair monetary penalization could be imposed. He (Mr. Watson) was inclined to think that the convenience of the horizontal plane test in dealing with several lamps at once had been a deciding argument with some. But it would not be difficult with the direct-reading instrument to contrive a suitable swivel head, which would facilitate quick reading of two to three lamps in succession. In any case there were some advocates of the horizontal method of computation who preferred, to secure greater certainty of result, to take direct-ray readings, and then correct to the horizontal-plane basis. He believed that, in the expression of these opinions, he was voicing the views and opinions of the great majority of the members of the Institution of Gas Engineers, and certainly those of the Council. They had no wish to be in any sense inappreciative of the work which had been done by the Joint Committee; but holding the views they did, they asked that, at the least, clauses should be included giving the alternative of reading the specification as dealing with minimum illumination computed and expressed in direct-ray foot-candle values. The form of the specification with such an alteration was not materially altered. The classification and grading of the streets were excellent. To fit in with the alternative clauses, all that would be necessary was to ascertain the direct-ray minimum illumination in the streets which were taken as examples for the purpose of the classification.

Mr. J. G. Clark (Gaslight and Coke Company) said it had been a great pleasure to him to read Mr. Trotter's paper. His work in connection with lighting problems, more especially those relating to public thoroughfares, was so well known; and there was very little doubt that when the history of recent illuminating engineering developments came to be written it would be seen that his work had played a very important part. Early in the paper Mr. Trotter said: "It is probable that some of those who disagree with the proposal to measure illumination directly on a horizontal plane have never used or perhaps seen a photometer for that work." He (Mr. Clark) would like to say at once that he found it difficult to agree with the proposal to measure horizontal minima; but he did not fall into the category of "some of those who disagree" alluded to by Mr. Trotter. The department to which he was attached not only had, but used, eight of the modern types of photometer; so that any remarks he made were, at any rate, based upon some little experience. He thought he might safely say that his "Trotter" photometer was a real "old soldier," and would probably vie with any photometer in existence in regard to the amount of work that had been done with it. Hitherto contracts for public lighting had been based on the measurement of candle power; and as one who had had considerable experience, he should like to say that this method had the very important merit of being capable of exact definition, and conduced to a complete understanding between the contracting parties. Any one who had had experience in specifications knew how important was exact definition. One looked, therefore, for some special advantages in a new method before adopting it. While admitting the usefulness of measurements of horizontal illumination, he was unable to say that they were capable of such exact definition as the measurement of normal illumination at a specified angle—that was, of course, candle power; and his experience had led him to believe that horizontal illumination should aways be subordinated to the more exact method. It would be interesting first to review Mr. Trotter's case for the horizontal method. It was stated in the paper that there was a great saving of time by adopting the non-mathematical horizontal method. He (Mr. Clark) had never experienced the mathematical tediousness alluded to by Mr. Trotter—a good slide-rule did the work quite easily. The large number of observations necessary to find the horizontal minima would, to him, be far more fatiguing than a simple calculation on a slide-rule. Mr. Trotter stated that the horizontal minima were extended over a considerable area, and therefore were easily found. Although this might be true in a number of cases, there were still many others where difficulty might arise. If one divided a thoroughfare into several parallel tracks—all parallel to the axis of the street—and explored the illumination along the centre of each track, one found the minimum sometimes in one track and sometimes in another, depending on the disposition of the light sources. In fact, his experience had led him to believe that a special exploration was necessary to find the minimum; and even then, owing to its usually low value, it would be difficult to be sure to within (say) 10 per cent. It would therefore seem that, if horizontal minima were to be taken for evaluation purposes, a definite position ought to be specified to avoid perambulation. Mr. Trotter dismissed the question of reflection from walls as being unimportant. It might, however, be important sometimes, especially if the wall was glazed. Regular reflection from the windows of houses was sometimes a really serious matter if not guarded against. It was these little things, that might sometimes though not always happen, that left so much room for misunderstanding where the horizontal minima were taken as a basis. Shop lighting also interfered with accurate measurements of horizontal minima, though the difficulty could be overcome by deferring the work until after closing time—a course that would not be welcomed by those who had to do the work. Mr. Trotter had admitted certain limitations of the horizontal method, owing to the high proportion that the extraneous light would bear to that due to the sources themselves. He (Mr. Clark) would like to say, however, that he had not found it difficult to narrow the field of view so as to avoid errors due to haze when taking candle-power measurements. But atmospheric conditions were very important; and he noted that a clause on this point had been inserted in the proposed specification. Mr. Trotter admitted that difficulties occurred where the angle of incidence of the ray on the test-plate was large, and pointed out that the specification permitted the test surface to be set normal to the ray of each lamp separately, and the result converted to the horizontal basis by adding the horizontal components of each of the lamps illuminating that point. Seldom less than three lamps would have to be dealt with in determining a horizontal minimum value; and this, together with the necessary perambulation to find the minimum, would make the work of manipulation and calculation very considerable indeed. Again, his experience had led him to believe that the conversion of normal illumination to the horizontal component, by calculation, was not always reliable. A comparison of calculated and measured horizontal values would sometimes disclose differences. What he thought was Mr. Trotter's strongest argument in favour of horizontal minima was the comparison of these minima with the findings of the surveyor members of the Committee. The agreement alluded to in the paper could be easily over-rated; and it was probable that other factors than the horizontal minimum illumination influenced their judgment. For instance, anything from 0·011 to 0·025 foot-candle inclusively were grouped into Class "B," whereas 0·027 to 0·034 foot-candle were grouped into Class "C." The agreement was certainly interesting; but there was sufficient latitude to cause one to think there must have been other factors—such as diffusion, glare, &c.—that weighed with the surveyor members. It must not be forgotten, too, that the surveyor members' judgment was probably influenced by the illumination of the surface of the street, and

also the vertical surfaces—walls, &c. Mr. Trotter was no doubt aware of the influence of the vertical surfaces—in fact, he mentioned it in the paper. "It is true," he remarked, "that a street with light-coloured houses seems to be better lighted than when the buildings are dingy." This brought them to the question of the height of the test surface. As this bore an important relation to the height of the lamp, it did not appear to him (Mr. Clark) sufficient to say that the standard height above the ground should be a metre. It would seem only fair that a special height for the test surface should be stipulated for each height of lamp. It was true that this would complicate matters somewhat, but this was just the difficulty he had found with the horizontal method. Unless the conditions were made flexible, equal justice would not be done to the various types of installation; and unless equal justice was done, there was some risk of penalizing unduly what might be a very good system of lighting—as for instance, low candle-power units on short posts. One of the terms that had now come into very common use in general illuminating engineering work was "the working surface." It was a very useful term, and one that could, as a rule, be construed under the various conditions. One simply ascertained the kind of work going on, and asked the question, "Upon what surface is the work done?" This question was asked when exploring the illumination of libraries, schools, workshops, offices, &c. Applying the same question to street lighting, Where did it lead? He could not see that it pointed to the horizontal surface—such, for instance, as would be represented by the crown of a pedestrian's silk hat. If one held a letter or a newspaper in a reading position, it was almost certain to be vertical or normal. A person passing along a street represented a peripatetic vertical plane. It therefore seemed to him that evaluation of street illumination by direct-ray methods was to be preferred to horizontal minima, for the following reasons: (1) Greater accuracy. (2) Equal justice to all systems; and therefore not penalizing unduly any particular system. (3) Expeditiousness. (4) More precise definition of terms. (5) Could be applied to all systems of lighting, and therefore made uniform; no alternative methods being necessary. In criticizing the horizontal method, he hoped he had not under-rated its value. It was, he thought, extremely useful in setting out an installation. Contour horizontal illumination curves should, he thought, always be taken into account in arranging the spacing of lamps; but in defining the terms of the contract, such curves should be subordinated to the, in his (Mr. Clark's) opinion, more precise method of normal illumination measurement. He had always felt that the question of diffusion, apart from illumination, had an important bearing upon popular ideas of street lighting, and was one that might be considered with advantage. It was probably a difficult question; but it occurred to him a day or two previously, that a measurement of shadow density would throw some light on the matter. He made a simple piece of apparatus consisting of a translucent screen fitted at the end of a square tube. A perforated screen was arranged so that it could be moved along the tube. The idea was that the rays of light from the source would cast a shadow of the perforated screen. The intensity of the shadow diminished as the distance between the perforated screen and the translucent screen increased, until it became practically invisible. It would seem that the diffusion would be in some way inversely proportional to the distance necessary to cause the shadow to vanish.

Mr. Haydn Harrison asked whether the measurements referred to were horizontal foot-candles, and what lamps were they.

Mr. Clark replied that they were horizontal measurements; and in the one case they were two-light lamps, and in the other case three-light. In conclusion, Mr. Clark, as a student of illuminating engineering, wished to acknowledge his indebtedness to Mr. Trotter. Mr. Trotter was, he said, an experienced leader in the science and art of lighting; and the perusal of his papers and remarks, which had been published from time to time, were certainly a valuable guide to those looking for light.

Mr. Franklin Thorp (Manchester) wished to take this his first opportunity of thanking the Council of the Illuminating Engineering Society for electing him a member, and Mr. Gaster particularly for the many kind communications received from him. It was a great pleasure to find, on his first visit to one of the meetings, so many gas engineering friends present, and to have listened to so excellent a paper as that presented by Mr. Trotter. Their thanks were due to Mr. Trotter and the members of the Joint Committee for instituting and preparing such an important specification; and nothing but praise could be accorded to them. It might, of course, be necessary to criticize some details; but he trusted his remarks would be accepted as an endeavour to assist the Committee in forming a standard specification which would not only be fair to all parties concerned, but would be as near an ideal one as possible. The Society was, in his opinion, doing excellent work. The Commission that was being held in connection with the lighting of factories and workshops, had, he believed, emanated from this Society, through their Honorary Secretary (Mr. Gaster). Improving the illumination of factories meant improving the conditions of labour; and the operatives of his county of Lancaster would be under a deep debt to Mr. Gaster when the recommendations, which he (Mr. Thorp) was sure the Committee would make, were carried out. There were, of course, many points in the specification which one would like to discuss; but considering the great importance attached to the question of horizontal or direct-ray measurement, he would confine himself to this point. Before doing so, however, he should like, as a student of diffraction, to call attention to the necessity of taking into account the quality or spectrum of the light. He did this, not only as a gas engineer knowing the pleasing effect of the incandescent gas-mantle, but because he believed it would tend to the production of a more pleasing appearance of lighting. They had now arrived at a stage where they could control quantity of illumination, and give a considerable amount for a small cost; and if means for specifying the quality of light could be found, he was sure that it would be a boon to the general public. He always carried in his pocket a small diffraction grating; and it was very interesting to compare the spectra of the various illuminants. On the previous evening, he had found the difference particularly noticeable between the electric arcs in Oxford Street and the high-power incandescents in Holborn. There was one other point before coming to the main one, and that was that gas men were careful to distinguish between the actual candle power of a lamp and the illumination at right angles to the direct ray. They quite realized the difficulty of simple candle power, as two lamps might have the same actual power, but the distribution curve might be quite different. Again, with a new form of mantles such as were now being experimented with, it would be difficult to get the mean hemispherical candle power, as the mantle was not a tubular one, but was oblong, giving nearly all its light in two directions. He had prepared several arguments against the horizontal illumination test; but, upon consideration, he believed he should be serving the best interests of the direct-ray advocates by confining his remarks to the table compiled by Mr. Haydn Harrison, and printed at the end of the paper. This table might have been prepared by, and for, those opposed to the horizontal plane test; and he felt sure that, after careful consideration of it, the horizontal test advocates instead of having confidence in being able to make converts that evening, would feel that they had become the converted. Mr. Harrison's table showed that the present horizontal test specification would be met equally well by a number of 32-candle power lamps placed 100 feet apart, and 36 feet high, as by the same lamps, 70 feet apart, and 10 feet high. This, of course, must look absurd to all of them. But Mr. Harrison was quite right in his contention and calculation. It was the method (and this was the objection of gas men) that was wrong. They could all imagine the actual lighting effect of the two installations; and when they considered that the actual direct-ray test would show a 7 to 1 difference—the actual lighting effect difference—he must ask for converts at once. It would perhaps be better for him to sit down, and leave the matter to sink well in, as he was afraid many friends had not previously looked at the matter in this light. He should just like to conclude by saying that, by the direct-ray method of measurement, it did not matter comparatively whether the test be taken on the floor or at 1 metre high; but in the case of the horizontal test, it made all the difference in the world, as, by Mr. Harrison's table, it would be seen that the 10 feet high lamp, tested at 1 metre high, as compared with a test at the floor-level, was penalized as 95 is to 62, taking lamps at 100 feet apart. He (Mr. Thorp) trusted that sufficient had been said to cause most of those present to use their influence with the Committee to insert the direct-ray test in preference to the horizontal one.

Mr. K. Edgcumbe (London) said he must say, with regard to this question of horizontal illumination, he was a "whole hogger." He must admit, after reading Mr. Trotter's most able exposition of the whole question, how thoroughly he believed he had put his money on the right horse. This was a very satisfactory feeling to have. Personally, when he came into the room after reading the paper, he could not conceive how anybody could possibly have any other view than that horizontal illumination was the right criterion. But there seemed to be a few wobblers. [Laughter.] He saw, however, that some of these gentlemen were sitting on the fence. He should like to draw attention to fig. 2, which seemed to him to answer all the objections that had been raised to the horizontal illumination basis. First of all they were told that, though it might be a more convenient way when measuring the illumination of a street to take the horizontal measurement, it was not the final measurement; it did not take into account all the physiological questions. One speaker said he thought the borough surveyors who had classified the streets by eye were influenced not only by horizontal illumination, but by other things, such as the illumination of houses, or vertical illumination. These gentlemen who were experts in judging illumination (they were all borough surveyors in London or the neighbourhood) were asked to classify these streets by the eye. With a life-long experience, they went out, and placed a number of streets in three groups; and some of the other members of the Committee were asked to measure the minimum horizontal illumination in those streets. They did so, and found that the streets as judged by the surveyors came into the classes allotted to them in the specification, which were the ones in which they were placed by the borough surveyors. This, to his mind, was conclusive that, at any rate, horizontal illumination did give what was wanted—it gave the actual illumination; it gave the figure which told them the illumination of any street. To an expert it was possibly satisfactory if he were told the candle power, and the number of lamps; but to the ordinary individual that was more or less meaningless. This, he thought, disposed of the physiological question. The next thing (and this Table I. quite disposed of) was the question of the difficulty of the measurement. These measurements, Mr. Trotter stated, were made without any difficulty. The minima ranged from 0·006 foot-candle upwards; and there was no difficulty. A great point had

been made of the simplification which could be introduced by measuring the candle power direct. He thought a good many speakers seemed to think that the specification laid it down that the illumination from the smaller units of light was to be measured direct. He believed Mr. Trotter showed in his paper that this was not so. The personal view of Mr. Trotter was that he should prefer to measure it direct; and he (Mr. Edgcumbe) was of the same opinion. But the specification did not say that the horizontal illumination was to be measured direct, whether the illumination was high or low. A good many members had the idea that it was only to be calculated from the candle power or direct measurements when the illumination was below 0·01 foot-candle. He did not think that this was so. If they did not like this, what were they to have? The other suggestion which had been made that evening (and it was new to him) was a direct-ray minimum; the alternative suggestion being candle power. There was a certain amount to be said in favour of direct-ray minimum; but he did not consider it was a patch on horizontal illumination. It was more complicated. If he took the direct-ray minimum north-west he got one thing; and if he took it south-east he got something else. The only specification which he thought had been largely used was the Westminster specification. But what a complicated thing it was! They had to give the candle power, height, and spacing of the lamps, and the angles at which the illumination was to be measured. These all served to complicate things. Then horizontal reflectors, and not curved reflectors, were to be used; because, presumably, it was feared that some genius might shoot all the light out at (say) 20° and 50°. This seemed to him very complicated. He thought it was just as logical to inquire into the pedigree of a sheep when a mutton chop was wanted.

Mr. John Darch (London) said Mr. Trotter had handled the details of the subject in his well-known fair and unbiassed manner—particularly so in dealing with the question of illumination *v.* lamp power as a basis of measurement. He had rightly shown that the public wanted illumination, and not lamps; for light was the commodity for which the public paid. Lamps were but the means to that end. Illumination was a blessing; lamps were a nuisance. The Street Lighting Specification Committee were therefore to be congratulated on adopting illumination as the basis of measurement. This was a big step in the right direction. But they had not gone far enough; for illumination was but the means to an end, and that end was the eye—the act of perception. He said emphatically that no system of street lighting was worth having that did not provide for visual and for physiological efficiency. It was therefore a matter for surprise, after all that had been said and written on the personal factor, and its related question glare, that it had had no consideration in the standard clauses, nor in Mr. Trotter's paper. Here they had a splendid opportunity of indicating to the public what modern science and advance had accomplished. The absurdity had been committed of engrafting a "cruel" modern high-power lamp on to an antiquated system of illumination, for which it was entirely unsuited. The actual effect of the present practice was so to affect the eyesight that the actual illumination was apparently, and therefore practically, reduced from half to one-tenth of its photometric value. Mr. Trotter and he were discussing this very question a short time ago, walking along Victoria Street, which professed to be well lit, and so it was as far as expenditure was concerned; but the glare of the lamps was such that they nearly fell over a heap of coals lying across the footway. [With Mr. Darch's enthusiasm for illumination questions, we can well understand him falling over anything when engaged in a discussion on it, and walking along a street.—Ed. J.G.L.] He was prepared to admit that there was nothing in the standard clauses to prevent the adoption of some scheme or principle designed to avoid the difficulties to which he had referred. But the serious thing about it was that the public and the contractor would take this specification as the last word in street lighting, and would naturally assume that every feature of the case had been considered. He suggested that clause 3 of the specification, which defined the minimum illumination for various classes of streets, should have an addendum to the effect that, where lamps were properly screened, the photometrically ascertained illumination to be provided might be 33 per cent. less. He had no hesitation in saying that a shielded light of 60-candle power would enable one to see better than with a 200-candle power exposed light. He asked if the illumination of private sources of light such as shops had been excluded from the lists given in the paper; and, if included, how were they to compare the public parts of the lighting in the various streets. He thought it ought to be made illegal for any shopkeeper to expose a visible light, either outside his shop or in his shop windows. The ultimate solution of perfect street lighting would be the employment of diffused light obtained by illuminating the house fronts. Diffused light was enormously more useful than direct.

[The discussion was, at this point, adjourned until Tuesday next, the 29th inst., at 7.30 p.m.]

The Strike in Belgium.—We are glad to learn that, up to the time of going to press, the strike in Belgium had not affected the stations of the Imperial Continental Gas Association in Brussels or Antwerp. No men were missing from the works in either city at the end of last week, and no trouble was anticipated. In Antwerp, the works are being watched by the Civic Guard.

DETERMINATION OF WATER IN COALS.

On the occasion of the Eighth International Congress of Applied Chemistry, held in Washington in September last year, a Sub-Committee of the Committee on Analyses, who had been appointed to consider the standardization of methods of determining water in coals and other fuels, submitted the results of their labours. The Sub-Committee was a very representative one—the members having been drawn from England, France, Germany, Belgium, Holland, Switzerland, the Transvaal, Canada, and the United States. The President was Mr. G. T. Holloway; the Vice-President, Mr. J. H. Coste; and among the English members was Dr. R. Lessing, who presented the report. This was written by the President and Vice-President, who, however, consulted those of the members of the Sub-Committee who were available. It was obviously impossible for the entire body to meet; but, in framing the report, every effort was made by the reporters to give due weight to the suggestions and work of those of their colleagues who had communicated with them. The report has been reprinted from the collection of original communications to the congress; and we have been favoured with a copy by Dr. Lessing. We give below an indication of its contents and the conclusions arrived at.

The purview of the Sub-Committee, as defined in a circular-letter issued by the President, included the consideration of: (1) The determination of moisture and of combined water, including water of hydration and of crystallization. (2) The limits of accuracy possible or desirable in general or special cases. (3) The errors which would be introduced into other portions of an analysis by the use of a defective method of water determination, as, for instance, in the case of fuels, where combined water other than that actually determined, would frequently be calculated out as hydrogen. (4) Methods of general application, or suitable only to special cases or types of fuel or mineral, such as the effect of the use, and limitations of the use, of so-called inert gases, absorbents, vacuum drying, &c. (5) Methods of sampling, storing, and of generally dealing with the material to be examined, so that errors other than those due to the method of analysis should be minimized. This was considered to be important in all cases, but especially in connection with coal and coke.

It was not found possible to cover the whole ground of the reference, since, owing to the fact that members had many other onerous duties to perform, the amount of active experimental work was limited. Nevertheless, a great deal of useful work was done on one most important branch of the subject—viz., the determination of water in coal; and many useful suggestions on other matters were received. Owing to the great preponderance of the work on coal, it was found necessary to confine the report to the consideration of fuel, though much is directly applicable to minerals. The work done has convinced those who have drawn up the report that the recommendations embodied in it can only be considered as of a tentative character, and by no means as indicating anything like finality. The Sub-Committee say the distinction, by analytical methods, between water present as "moisture," "water of combination," and "water of crystallization" offers great difficulty "in view of the varying conditions under which different substances part with water present in the two latter forms, and of the fact that the amount of water present in the somewhat indefinite form of moisture appears fairly sharply defined by the nature of the substance with which it is associated and the atmospheric conditions prevailing at the time."

On the suggestion of several members of the Sub-Committee, a series of six samples of coal marked, ranging from an anthracite to a coal containing upwards of 12 per cent. of sulphur, were sent to members who were able to do experimental work for the report. They did not cover the range which had been desired; but shortness of time rendered it necessary to send what was available. The following table shows the approximate percentages of moisture, volatile matter, and ash in the samples:—

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.
Moisture	3	10	8	6	7	8
Total volatile matter, *ex* water	5	35	34	23 (*ex* sulphur.)	33	27
Ash	8	3½	4½	37	8½	10

The Sub-Committee give these figures merely as an indication of the type of coal. No. 1 is an anthracite from South Wales. No. 2 is from the "10-yard" or "thick coal" seam of South Staffordshire, which has never yet been coked in practice. As mined, it contained 10 or 11 per cent. of water, 5 per cent. of hydrogen, and 13 per cent. of oxygen. No. 3 is from the Kilburn seam of Leicestershire, and is a coking coal largely used for general and household purposes. No. 4 is a coal from South America, and is interesting in connection with moisture determination on account of its high content (4·2 per cent. volatile and 8·2 per cent. non-volatile). No. 5 is an ordinary bituminous coal from Leicestershire. No. 6 is a somewhat less bituminous coal from the south-east of Scotland.

Members of the Sub-Committee were asked to determine the moisture in the coals sent to them by (1) the American standard method, (*a*) heating for one hour and (*b*) two hours in a toluene or similar bath; (2) the method ordinarily employed by them; and (3) a vacuum method if the second was not one.

Full details are given of the work done with each method, as

well as with others not indicated; and then the Sub-Committee summarize their work, and come to the following conclusions.

1.—It does not appear that at present any means exist for distinguishing by analysis between added water "moisture" (which term we take to signify water of adsorption—*i.e.*, that due to a concentration of water on the surface of the particles) and water of crystallization or of combination, whatever the latter somewhat indefinite term may be supposed to mean.

2.—It is probable that the distinction between moisture and water of combination is of little moment in the case of coal, since the losses of water (*a*) at ordinary temperature under greatly reduced pressure, and in the presence of suitable means for reducing the tension of aqueous vapour to an inappreciable quantity (desiccants), and (*b*) at temperatures a few degrees above the boiling-point of water, do not differ seriously.

3.—Coal is a substance which very readily undergoes oxidation; and the best results in the determination of water are only to be obtained when the coal is treated in an atmosphere containing no oxygen.

4.—Coal is a very hygroscopic substance, and before being dried must be properly protected in the laboratory from the effects of changes of temperature or of atmospheric conditions. When dry, it must be protected from any contact with moist air or with moisture in any form until the determination is finished.

5.—Unless the initial rate of drying is known to be very rapid, the drying should be divided into two periods of which the latter is much longer than the former. Unless this is done, it is probable that an almost constant small loss, continued over a very long period, may be mistaken for an appreciable loss.

6.—When the initial rate of drying is very rapid—*e.g.*, at 105° C. or thereabouts—the gain of weight by oxidation may very soon become greater than any loss due to a very slow rate of drying over a long period.

7.—There is no advantage to be obtained by drying coal at temperatures above that of the atmosphere but below (say) 105° C.

The Sub-Committee point out that the accurate determination of water in a small sample of coal is a matter of difficulty and requires grave consideration. In the case of large samples of relatively coarse coal, the matter is of even greater difficulty. They put forward the following recommendations, believing them to be sound, and having due regard to the requirements of both the industrial and the research chemist; but they do not suggest that they are final. They ask workers to give them serious consideration with a view to their adoption.

Recommendations.

1.—Whenever possible, especially in the case of very moist coals, the water in the original sample should be determined, after it has been subjected to a minimum amount of preliminary mechanical treatment (*e.g.*, thorough mixing with rapid crushing of lumps), by either of the following methods: (*a*) A carefully weighed portion of from 100 to to 500 grammes of coal is spread out in a metal tray and exposed for at least 24 hours to the atmosphere of the sampling-room. The tray containing the coal is then re-weighed, and the percentage change of weight is calculated. The coal is then coarsely ground in a mill (a ball grinder is best), and the water determined in the ground portion by one of the methods given in recommendation Nos. 2, 3, or 4. The water on the original sample can then be calculated. (*b*) The xylene method used by Dr. Constam, and given in recommendation No. 5—all results to be calculated back to the original coal.

2.—For ordinary technical work, coal should be dried in an oven with a good air circulation, for a period not exceeding one hour, at a temperature not below 104° nor above 111° C. It is advised that two portions of one gramme should be weighed between pairs of accurately fitting watch-glasses or in a shallow weighing-bottle which have been heated to the temperature of drying and cooled in a good desiccator, and be dried for periods of half-an-hour and one hour respectively, the upper glass or the lid of the bottle being removed during the period of drying, at the end of which it should be replaced loosely, and the covered vessels placed in the desiccator to cool. At the end of the period of cooling, which should be equal to that allowed for the heated empty glasses or bottles, they should be re-weighed and the percentage loss calculated. The higher result shall be considered as the percentage of water in the coal. The required temperature can be obtained by the vapour of boiling toluene (111° C. at 760 mm.), by steam at a pressure of 906 to 1100 mm., or by an electrically heated thermostatic arrangement. We advise that a long oven with a door in the small end should be used. A toluene oven with a preheating arrangement for the air current, as described by Siaw [in the "Journal of the Society of Chemical Industries," 1911, No. 61], or other similar device, is, in our opinion, a practical arrangement. We strongly condemn air-ovens and all devices in which the temperature of the walls of the drying chamber is variable. We believe that a fairly uniform temperature in the whole of the interior of an oven is only to be obtained when the heated walls have an area large compared to the cubical contents of the interior, and are themselves at a uniform temperature. A preheated supply of air is to be desired. Mere heating without a proper air current is unreliable.

3.—Whenever it is suspected that a coal is specially liable to oxidation, or the half-hour and one-hour results differ materially, drying at 104° to 111° C. in a current of nitrogen or carbon dioxide is to be preferred to drying in an oven through which a current of air is passing. Either the direct or indirect method of estimating water may be used. If the former is chosen, care must be taken to prove the dryness of the stream of gas which is passed over the coal. The percentage of free oxygen in this gas must be inappreciable. This method of drying in a current of inert gas is to be preferred for all very exact work.

4.—Drying to constant or minimum weight in a vacuum in the presence of sulphuric acid (or other desiccant) possesses no advantage over the last-mentioned method. It is very much slower, and, unless the vacuum is very high, it is better to fill the desiccator with carbon dioxide, or other inert gas, before exhausting. If this method is preferred, a Hempel desiccator, or any other form in which a large surface of sulphuric acid is exposed both above and below the coal, should be used. The coal should be weighed in watch-glasses or shallow weighing-bottles, and the loss after (say) 24, 72, and 144 hours should be taken. With such prolonged periods of drying, the results obtained by this method are practically identical with those by method No. 3. The air admitted into the vacuous space should always be dried by passing slowly through or over sulphuric acid.

5—The method of drying-off water from coal, by heating in boiling xylene and measuring the water which distils over with the hydrocarbon, is a variant of the method of drying in an inert atmosphere at an elevated temperature. It is worthy of serious consideration, and, although we cannot, in view of the limited information at our disposal, recommend it unconditionally, we consider that it is most promising, and appears to be particularly suitable for industrial purposes.

6.—Coal should always be weighed in closed vessels with well-fitting lids or stoppers. Deep vessels, such as crucibles, are unsuitable for water determinations. Porcelain or metal boats which can be weighed in stoppered or well-fitted sliding tubes may be used.

7.—Desiccators with the strongest sulphuric acid, which is frequently renewed, are recommended. If calcium chloride is used, it must be ignited before it is put into the desiccator. If phosphoric anhydride is used, it must frequently be stirred. These substances are not nearly so convenient or reliable as sulphuric acid.

It may be of interest to reproduce from the reports the following particulars of the xylene method referred to in the fifth recommendation: From 40 to 50 grammes of coal (100 grammes of coal of low water content) are weighed into an Erlenmeyer flask of 500 c.c. capacity; 200 c.c. of xylene are added; and 150 c.c. of this are distilled over (the flask being heated on a sand bath) into a measuring chamber, the lower part of which is divided to 1-20th of a cubic centimetre. The measuring vessel is then hung in a cylinder with warm water. Any drops of water which hang about the shoulder of the measuring vessel are detached by means of a glass rod, and allowed to fall to the narrow part. After standing for one hour, the volume of the water distilled over with the xylene, and which has separated under it, is measured—due correction being made for the meniscus. The results obtained were: Coal No. 1, 3; No. 2, 10·38; No. 3, 7·8; No. 4, 6·16; No. 5, 7·74; No. 6, 7·6. The method is ingenious, and, in the opinion of the reporters, has many advantages, and might be well made the subject of further trial by other workers.

Yield of Catchment Areas in Scotland.

This was the subject of a paper read at a recent meeting of the Institution of Civil Engineers by Mr. W. Carstairs Reid, who dealt with the yield of several catchment areas in Scotland which for a number of years past have been under the observation of himself and his firm. The areas under review are situated respectively in the counties of Peebles, Midlothian, and Perth. Reference was made in the first place to the observations having been undertaken on one at least of the areas because the information available in regard to rainfall was insufficient to permit of the proper quantity of compensation water to be given being determined by a parliamentary tribunal. A comparison was made between the rainfall and the actual flow of the streams according to steam-gauge recorders or having regard to the rise and fall of water in reservoirs of known capacity. The results of observations on an evaporation gauge at the Talla reservoir, Peeblesshire, were given. The extent of the Peeblesshire catchment areas is 6180 acres, taken as a whole; but separate information was given in regard to a portion of this area amounting to 3000 acres. The Midlothian area is 3825 acres; and the two Perthshire areas are respectively 1166 and 1437 acres. Information was given by the author in regard to the minimum flow in the areas for various different periods, such as a week, a month, and four and five months.

Location of Hidden Pipes.

Reference has already been made in the "Journal" to a portable apparatus designed by Messrs. Edwin A. Mansfield and Co., of New Brighton, Cheshire, for locating hidden pipes; and in the number for Jan. 14 last (p. 98) it was described and illustrated. We learn from Mr. Mansfield that an official test of the "locator," as it is called, has been made by the Metropolitan Water Board, at the request of Mr. H. F. Rutter, M.Inst.C.E., the Engineer for the Western District. A number of the Assistant-Engineers of the Board accompanied Mr. Mansfield to a position in the Hampstead district, where they located a known arrangement of pipes, and chalked them out on the roads and pavements. The next test was made to find the main to the reservoir, which was not on any plans available. We are informed that not the least difficulty was experienced in getting the position; and on driving a bar down a distance of about 3 feet, the top of the main was reached exactly. A similar result was obtained at the hands of Mr. A. E. Ball, of the Wandsworth, Wimbledon, and Epsom District Gas Company. The testing party went to one of the out-districts, and nobody knew the position of the gas-main. The terminals of the instrument were fastened to two lamp-posts about 100 feet apart, and the main was found close to the hedge on the inside of the footpath. To verify this, Mr. Ball was requested to get his man to dig down in two places some distance apart; and the result was that the mains were at the positions found. Rain was falling very heavily at the time; but all the work was over in less than one hour.

TAR FROM CONTINUOUS VERTICAL RETORTS.

This was the subject of a paper read by Mr. T. STENHOUSE, of Rochdale, before the Manchester Section of the Society of Chemical Industry early last month. It may be remembered that an abstract of the paper, with some notes of the remarks made upon it, was given in the "JOURNAL" at the time; but the full text is published in the current number of the Society's "Journal," and we reproduce it, with the fuller report of the discussion by which it is accompanied.

Although vertical retorts have become practicable comparatively recently, some attention has already been given to the nature of the tar produced by them; and the subject is discussed in the most recent books on the manufacture of coal gas, &c.

As mere carbonizers of coal when a large yield of gas is required, it is difficult to see how vertical retorts can be much improved upon. As regards the question of residuals, it was estimated in 1908 that smaller quantities of coke and tar would be produced, but an increased market value of 5s. per ton for the improved quality of the tar. I do not think this expectation has been confirmed. So far, no increase in tar value has been apparent at Rochdale, where vertical retorts of the continuous type have been in constant use for nearly eighteen months. There may, however, be a greater yield of tar per ton of coal carbonized; but this has not been proved, as circumstances do not allow of the tar from the verticals being kept separate.

During the last thirty years, the tar made at the Rochdale Gas-Works has been distilled and separated into such products as 50-90's benzol, solvent and heavy naphthas, crude carbolic acid, creosote oil, and pitch. Ample opportunity has therefore been afforded of ascertaining the quality and quantities of the products obtained from tar derived solely from the horizontal and inclined retorts which were in use before the verticals were erected. The tar from the continuous verticals at Manchester has a specific gravity of only 1·074, compared with 1·113 for the tar from the intermittent verticals at Sunderland.

As the coal slides through the cold upper parts of the continuous vertical retorts, considerable time must elapse before it attains to the highest carbonizing temperature of the setting. Possibly a large portion of the coal entering each retort is subjected to low-temperature carbonization; and the resulting gas, as well as the tar, must be richer in the saturated hydrocarbons of the paraffin series, but poorer in unsaturated and aromatic hydrocarbons.

Probably the tar-yielding vapours given off in the upper part of the verticals could be altered somewhat in character, without destroying any of the saturated hydrocarbons of the gas itself, by being deflected, by means of a shield, to a slightly greater extent than is the case at present, to a hotter part of the retort, before they escape by the ascension or descension pipe, as the case may be. This would probably cause some of the liquid low-temperature paraffin products to be broken up into permanent gas and compounds richer in the benzene group. Especially might this be expected from the decomposition of the pseudo-olefines, like hexahydrobenzene and its homologues. It has also been shown by Haber that hexane breaks up almost entirely at a comparatively low temperature into ethylene and methane. In the gas from the verticals, the unsaturated hydrocarbons seldom amount to more than 2·1 per cent.; while the gas from the inclined retorts rarely gives less than 3·6 per cent. with the same class of coal. The gas from the verticals is poor in ethylene.

QUALITY OF THE TAR.

Respecting the quality of the tar, the following particulars may be given: When taken from the hydraulic main, the tar is quite fluid, but becomes very viscid on cooling. After it has stood for a few hours at this temperature, patches of water separate on the surface. When this water is removed, the well-mixed tar at 50° C. has a specific gravity of 1·09 to 1·1. After standing some time in the common tar-well, the tar from the verticals contained much more water in suspension than that from the inclined retorts when allowed to accumulate in the same way. This was very noticeable when the new tar came to be distilled in charges of about 11 tons. The tar had a great tendency to froth-up and boil over. At the end of the condensing worm rushes of steam escaped irregularly along with foul-smelling gases from the contained water, and unusual little explosions in the tar-still could be heard. It therefore took many hours to get rid of the water before quiet distillation was established.

During the working of a tar-still, a change of receivers was made from light oil to creosote oil at 4° Twaddel; and steam was applied to the boiling tar when the density of the distillate was equal to 7° Twaddel. On finishing a still so that the hot pitch would run off freely and yield the medium soft grade, it was necessary to stop distillation when the anthracene oil was at 13° Twaddel at 15° C. If this 13° finish was not adhered to, the pitch would not leave the stills freely. With the tar from the horizontal and inclined ovens, however, the distillation had to be continued to at least 19° Twaddel, or the resulting pitch would be too soft.

CREOSOTE OIL.

The creosote oil from the old tar had a density of 9° to 10° Twaddel, with a tendency to become pasty and deposit naphthalene. With the advent of the new tar, the density of the oil began to fall until it stood at less than 3° Twaddel; and the oil would remain quite fluid at 0° C., though much naphthalene was present. This creosote contained at least 16 per cent. of tar acids; but none of a crystallizable nature that could be sold as crude carbolic. Such creosote oil was obviously rich in cresylic acid.

This low-density creosote consisted partly of what came from the distillation of the tar between 4° and 13° Twaddel, and partly of the oil residues from the light-oil and naphtha stills when these were worked until the distillates became pasty on cooling. These latter residues were therefore sufficiently light and of sufficient quantity to reduce the whole of the creosote below 3° Twaddel, so long as the tar came entirely from the verticals. Owing to the low density of the oil, it is difficult to get it sufficiently free from water for commercial purposes.

Some contract notes for creosote oil stipulate that it must contain not less than 8 per cent. of tar acids; that the boiling-point must not be less than 400° Fahr.; that at least 25 per cent. of the oil must not distil over at 600° Fahr.; and that the first 25 per cent. that does distil over must be heavier than water. The light creosote oil yielded by the tar from the verticals complied with all the particulars just given, with the exception of the last one. The first 25 per cent. distillate was lighter than water. On the other hand, the oil contained twice the amount of tar-acids required. Thus paraffinoid compounds of a low specific gravity were present in much greater quantity than in ordinary creosote oil derived from coal tar.

CRUDE CARBOLIC ACID.

The amount of phenol or crude carbolic acid obtainable from the new tar was at least 25 per cent. below the usual quantity, and the crystallizing point of the usual distillate fell from about 60° Fahr. to below 40° Fahr. This decrease in quantity was due to the use of a weaker solution of caustic soda, in order to obtain a crude acid that would crystallize and be merchantable. From 800 gallons of the light oil given by the old tar from horizontal and inclined ovens, 40 gallons of 60's crude carbolic were readily obtained; but less than 30 gallons of a lower quality came from the new tar—all other conditions of treatment being similar.

The new tar is therefore poorer in phenol but richer in the acids of higher boiling-points. In the usual distillation test for crude carbolic, a distinctly higher temperature than usual was reached before the required 62½ per cent. distillate was obtained, owing to the difference between the boiling-point of carbolic acid and that of cresylic and other acids.

BENZOL AND NAPHTHAS.

With the new tar came a smaller yield of benzol but a larger one of solvent and heavy naphthas. Their composition and specific gravity also differed. For many years the density of benzol and solvent naphtha stood very steadily at about ·880, and that of the heavy naphtha at ·910 to ·920; but recently the specific gravity of the 50-90's benzol had dropped from ·880 to ·860, and that of the solvent naphtha to ·845.

By fractionating either ordinary benzol or solvent naphtha, it was easy to obtain successive distillates having boiling-points which rose steadily, while the specific gravities of the distillates decreased considerably. The residue in the flask—about 20 per cent.—was the lightest portion of all. That part of the solvent naphtha which distilled over between 140° and 160° C. would often have a density less than ·840. The ordinary heavy naphtha, of which the tar from the continuous verticals gave a good yield, would give no distillate below 160° C., though the specific gravity did not exceed ·880 and was often less, and therefore lighter than ordinary 90's benzol.

It would appear from these results that the benzol and solvent naphtha contain appreciable quantities of the paraffin hydrocarbons which boil between 70° and 175° C. In the heavy naphtha and light creosote oil, a greater percentage of the still higher members of the paraffin series must be present, all of which lower the density of the tar products in which they occur without materially affecting their boiling-points or distillation properties.

PITCH.

Tar taken from the hydraulic main and heated in porcelain dishes in an ordinary air-oven gave 65 per cent. of medium soft pitch or about 50 per cent. of very hard pitch. A similar pitch result was obtained when the tar was distilled in glass vessels without the aid of steam.

CONCLUDING REMARKS.

So far as can be judged by the experience with the continuous verticals at Rochdale, there is no naphthalene trouble with the gas nor with the creosote oil or the naphthas, nor has there been any difficulty in selling the various liquid products at the ordinary ruling prices. It was different, however, with the crude carbolic acid, of which there was a considerable shortage in both quantity and quality.

As the tar from continuous vertical retorts becomes more plentiful throughout the country, it will be found, I think, that the large amount of tar acids present causes much greater corrosion inside the tar-stills than has occurred hitherto.

It appears quite certain that in the near future ordinary gas-works tar will contain a considerable amount of paraffin or low-temperature compounds, particularly where carburetted water gas is also made; and this fact will have to be taken into consideration when the final products are placed upon the market in

increasing quantities. At present the amount is probably insignificant. Even in works where vertical retorts have so far been established, much more tar is obtained from the older plant than from the new; and the whole mixture will not show any great difference to the general tar distiller.

DISCUSSION.

Mr. W. H. Coleman thought the conclusion that there was an increase in the content of paraffinoid bodies in the tar could not be controverted; and the tar appeared to approximate rather to some of the old tars that were obtained in the very early days of gas making, when the coal was heated to a very much lower temperature than at present. He would like to have some comparative results of the tests of the two tars. For instance, the percentages obtained at different temperatures of distillation on a small scale would better enable the chemist to compare the difference. He presumed that the vertical retort tar was entirely unmixed with any horizontal or inclined retort tar. Then there was the question of the different specific gravity. The variation between the different kinds of tar from vertical retorts was interesting; but he did not think it was very important, because with ordinary horizontal retort tars considerable variations were obtained—say, between 29° up to 40° Twaddel—depending upon the method of distilling the coal. An important point which Mr. Stenhouse had not mentioned was that of the pitch and the free carbon in both the tar and the pitch. One of the greatest differences between vertical and horizontal retort tar was in the content of free carbon. The present-day ordinary tar contained anything between 15 and 25 per cent. of so-called "free carbon." All the samples of vertical retort tar he had seen, or the analyses he had seen, showed only from 3 to 7 per cent. This had a very important bearing upon the uses to which the pitch was put, especially that of road making. It was interesting to learn that there was less crystallizable phenol obtained from vertical retort tar, though one or two laboratory samples he had had did not quite bear this out.

Mr. F. Scholefield said it would be interesting to learn how the percentage of anthracene in tars from vertical retorts compared with that from tars from other retorts, and also whether Mr. Stenhouse was in possession of figures showing the relative percentages of carbazole, which had of late become an important product as the starting-point for vat dye stuffs.

Mr. Bailey said one interesting point in the paper was that in the case of one distillate it had been discovered that, as the boiling-point went up, the specific gravity went down. This was entirely contradictory to ordinary tar distillation. It seemed as though when the boiling-point went up the percentage of the paraffin series increased in the particular distillate. Perhaps the paper might be the means of inducing someone to try to separate the paraffins and the benzol series. It would be very interesting if it was found by future work at what temperature coal would give off paraffin oil bodies, and at what temperature it would give off benzol bodies. It seemed to him there was a great deal in Mr. Stenhouse's suggestion as to carrying the shield further down the retort, and possibly getting the gases and the tarry vapours given off from the retort at a different temperature. It certainly seemed at present as if distillation in vertical retorts was really a fractional distillation of the coal; that those constituents were first driven off which would distil at a comparatively low temperature, and that as the coal came down the retort a higher temperature was obtained, until it reached the centre of the retort, where the whole of the remaining volatile products were driven off. From the point of view of the coking industry, the paper was exceedingly interesting, as in the case of that industry an endeavour was always made to maintain the highest possible temperature in order to get the hardest coke. It was well known that at the start of the charge, when the cold, wet coal had considerably cooled the inside wall of the oven, very different products were given off as compared with those obtained five or six hours afterwards.

Mr. E. Ardern said he had not gathered any definite opinion with regard to the relative value of the two tars. He understood the author to state that the market values of the two products were similar. From the percentages of free carbon, it would appear that the vertical retort tar pitch might be much more valuable for road making purposes than that derived from the horizontal retort tar. In fact, the figure of 4 to 7 per cent. for free carbon more nearly approached a natural bitumen, which was considered very much more preferable for road purposes than the ordinary coal-tar pitch. Again, he gathered that the creosote remained much more fluid, and that there was very little, if any, separation of crystalline compounds. Consequently, it would appear that for the impregnation of wood or any other similar purpose such creosote might possess considerable advantages over the creosote yielded by the tar obtained from horizontal stills.

Mr. R. H. Clayton said that he was very pleased to hear the author's statement that the tar obtained from vertical retorts was of no greater value than the ordinary tar obtained from horizontal or inclined retorts. Such a remark, coming from such an unbiassed source, must have much weight, and was therefore of great value to the tar industry. He (the speaker) would like to mention the presence of the paraffinoid bodies. Of course, in previous times, the presence of paraffin bodies in benzol was a matter of great objection to aniline makers, and very strict tests and rules were made that no paraffin should be contained. But the times had changed. The quantity of benzol used for the colour industry at the present time was small compared with that produced. The greatest outlet for benzol was for motor purposes; and the product from vertical retorts in this respect was practically equal to the benzol which was previously obtained. As regards road treatment, it was possible that the pitch, being comparatively free from carbon, would tend to flow more, which was a very objectionable quality if used for roads.

Mr. Stenhouse, in reply, said he did not make an analysis of the tar on a small scale, as it was difficult to get a fair sample of the whole product. At this time it was more interesting to note the ordinary working results. When cold, the tar from the hydraulic main was very thick, from some cause or other, but was quite fluid when warm. The mixed tar from the well was thin and light—something like that referred to by Mr. Newbigging as obtained at Manchester. One point he did not quite understand was that when some of the tar was heated in an open dish in an air-oven, all the ordinary volatile products readily passed away, though the temperature never exceeded 190° C. At least half the weight of the tar could be driven off at this temperature, yet if the tar was heated in a large glass retort or flask it required at least that temperature to expel the water and light oil, and a much greater heat to get away the creosote and anthracene oils. With regard to the tar acids, phenol was undoubtedly scarce in the tar from the verticals, while the acids of higher boiling-point were plentiful. After applying steam to a charge of tar when the distillate was about 7° Twaddel, there was a rather rapid run to a finish, and less anthracene oil than usual was obtained. The quality of this oil was ignored, as it all went to the creosote portion. Therefore he could not say what amount of carbazole was present in the anthracene. He scarcely thought that the pitch was more like bitumen, because it was often quite brittle, and small pieces could be readily crushed to a fine powder between the finger and thumb. So far as could be judged by appearance, there was no material difference between the pitch obtained from the new retorts and that derived from the old ones. For this and other reasons, he was of opinion that a better price was not to be expected for tar from vertical retorts. There was not now the same necessity for benzol and naphtha being of the particular quality required by colour makers. A large amount of naphtha was used for cleansing purposes, and there was now a great demand for benzol for motor cars and waggons.

INDUSTRIAL FUEL AS A REVENUE PRODUCER.

HOW TO DEVELOP THE LARGE CONSUMER.

By John S. Welch, of Philadelphia.

[A Paper read before the American Commercial Gas Association.]

That industrial fuel is a revenue producer has so often been proved that it is now an accepted fact by the managers of gas companies, and they are all endeavouring to get business of this class. The question of rates has a direct bearing on the amount of industrial business that can be obtained in any situation. Naturally, a low rate will assist not only in securing the available business, but will open-up a field that cannot be entered without comparatively low rates.

The developing of a large consumer is usually gradual, and requires the efforts of a well-organized and a carefully-trained industrial division. It is believed that the ways and means here discussed to obtain the industrial appliance business will serve as a guide for other gas companies, whether their division be large or small, a division of one man or a division of many men. How this can be done is best explained by reviewing the working of the industrial division in the Philadelphia Gas-Works, which has under its care factory appliances, factory illumination, and gas-engines, with a rate of $1 per 1000 cubic feet.

Development of Salesmen.

Great care is exercised in employing the right kind of men for the making of industrial salesmen. Beginners are chosen who are not too young. They must have a good education, appearance, personality, ambition, and some mechanical training or a liking for mechanics. With these qualifications on which to build, the beginner is taken first into the office of the division, and there taught the principles, the spirit, and the policy of the Company towards the public. Here he is under close observation, and here it is determined whether or not it would be well to continue his up-building. If during the preliminary training he stands this test, he is, when the opportunity presents itself, transferred to the appliance inspection and repair force, and later to the selling force. Through these different stages of his education his development is gradual or rapid according to the strength of purpose of the individual to succeed.

It is the endeavour of the Company to enlarge the knowledge of the industrial division employees in every way. To this end, salesmanship is taught. Qualified employees from the commercial, distribution, and manufacturing departments address weekly evening meetings; appliance manuufacturers talk on industrial appliances; and the members of the division work-up papers for discussion.

A question and answer box is maintained; trips are taken to different manufacturing stations of the Company—the meter shop

and gas-works, &c., to the shops of gas-engine, illumination fixtures, and appliance manufacturers; and the men at times take apart and reassemble gas-engines, appliances, and illumination fixtures in the appliance demonstrating room, which is a part of the division's equipment.

Comparative studies of gas and electric lighting are made by the use of the dark room and blackboard diagrams. Power and fuels of all kinds are studied. Technical magazines and trade journals are subscribed for, and pertinent articles in them discussed; and "talks" are given on industrial and illuminating appliances and gas-engines.

This is done in order to instil into the organization the spirit of pulling together, one man with another. This educational policy has proved productive of good work in bringing the Company nearer the consumers through its employees; and, in addition, the office force is taught to help the salesmen to become more efficient, thereby aiding the development and efficiency of the whole organization.

These are the means employed to effect two ends—one that the representative will have a justified confidence in himself and the Company; and the other that in everyday work he will inculcate a like confidence in the minds of the consumers with whom he does business.

Factory Appliance Sales.

It is the duty of the sales representatives of this division to know how to advise, assist, and direct the consumer in the sale and purchase of industrial appliances and their uses. He must know more. He must know company practices, in order to be able to convince all consumers with whom he comes in contact that the Company are sincere in their desire to serve them.

Industrial division sales representatives must be able to keep old business as well as to get new business, as shop costs of getting results are being continually checked, and methods investigated to cheapen the cost of production. The industrial representative not only should take orders, but must learn if every gas condition with the factory is satisfactory. This is considered to be a demand of importance, for if there is a complaint on company service the representative must see that it is adjusted and the consumer satisfied. It is the duty of each sales representative to have every appliance in good condition put into use, or sold to another consumer for use. There is more to be gained in having this done than if a new appliance had been sold.

We have divided Philadelphia into seven selling districts; and each industrial sales representative has entire charge of the factories in his district. Periodical visits are made to all of them, and the representative is held responsible for a satisfactory increase of consumption at them. This is believed to be the true way in determining the value of the work of the salesman.

A history card is kept of each factory in the several selling districts, and upon it is recorded the sales made, the future prospects for sales, and a note of every appliance using gas and those appliances using other fuels for which it is believed there is a possibility that gas can be substituted.

At the time of the sale of an appliance, the salesman takes the order for its connection if any is needed, uses the Company's book of pipe specifications, and lays out the work. He then gives the consumer a labour and material estimate for the connection; and if this is accepted, a sketch is made and sent to the shop, from which sketch the fitter does the work. When this is completed, the cost of doing the work is returned and compared with the original estimate. This method of the representative giving a labour and material estimate for doing work is an effective way of selling; for to have to call for help to make an estimate to close the sale will cause delay, and the opportunity for business may be lost. This method of handling orders will also show to the consumer that the salesman has the ability to execute this kind of work. The making of estimates is also followed when selling gas-engine erections and illuminating appliances. Working under this sales policy during 1911, the increase of consumption in 3200 of 6000 factories was 44,410,340 cubic feet compared with that of the preceding year—a gain of 12½ per cent. These figures are actual, having been taken from the Company's ledgers.

Factory Appliance Inspections and Repairs.

It is the belief that substantial progress cannot be made in the development of the industrial gas business unless means are provided to keep old consumers. Consequently it follows that a factory appliance repair and inspection force is a necessary adjunct to any industrial appliance division. To this end a history card is kept, giving the condition, use, and hours of burning of every industrial appliance in the city. Using these cards, periodical inspections are made in every factory to make adjustments, if necessary, and advise as to the correct use of industrial appliances.

All new factory apparatus installed and existing gas-consuming appliances are regularly inspected for satisfaction and condition; and, where possible, inspectors will teach the workman in the factory in which the repairs are needed how to make minor adjustments. This policy of teaching is educational. It demonstrates the simplicity of the repair, which, having been done under direction, is thereafter as easily done without it. Moreover, this practice is helpful in gaining the confidence of the consumer, from the fact that the Company will devote time for teaching. Inspectors carry tools for making repairs. Orders are taken by them for appliance repair parts at cost.

There is another value to be derived from men engaged in this class of work. During their work they find very many prospects for business which they turn into the office, to the advantage of the district industrial salesman. Many of these prospects have resulted in new business.

Another duty of importance of the factory appliance repair and inspection force is their qualification to investigate disputed consumption. In cases of this character, it is usually proved that the consumer is burning gas uneconomically, which results in a complaint of consumption above the normal. This condition is remedied by corrected adjustment of the appliances in use, and is not the fault, as is generally believed, of a meter registering improperly.

Gas-Engine Sales.

In 1911, there were 188,855,400 cubic feet of gas sold in Philadelphia through gas-engines. Each prospect is developed by members of the division to the point where a purchase is certain, at which time one or more gas-engine manufacturers are made aware of the fact, and the opportunity is offered them to obtain the order.

The cost of developing prospects up to the time of purchase, of maintaining a gas-engine repair force, of a gas-engine running in a show window, and of gas-engine advertising, constitute the expense incurred to develop this business, which is considered to be a profitable one. In 1911, there were sold 221 engines, representing 1722 H.P., with an average of 18,100 cubic feet of gas per horse power per annum.

Gas-Engine Inspections and Repairs.

Under the heading "Factory Appliance Inspections and Repairs," it has already been stated that such a force is necessary to protect existing business. Here, again, there is a like belief that the gas-engine business can only be fostered by having a gas-engine inspection and repair force. It is the work of this body of men to inspect for reliable and economic running; but, upon demand, they also make minor repairs to every gas-engine in the city. These mechanics sell repair parts for the engines at cost—labour being furnished free. They also accept responsibility for the satisfactory erection of gas-engines, whether erected by the Company, the individual, or the dealer. A history is on file of every gas-engine in the city. On this card are written the condition of the engine, the repairs made, and the labour cost.

That this free mechanical service is one of value to the company is evidenced by the increase of business in the number of engines sold, and by the fact that the consumption per horse-power-year has increased from 15,100 in 1909 to 23,700 in 1912.

An additional duty, and one of importance, of the gas-engine inspector is the examination of every disputed high bill where a gas engine is in use. A high bill complaint is analyzed, not by first considering the meter and having it removed for test, but by examining the engine to see if it has worn parts that may cause it to use an excess quantity of gas. In the majority of cases this is found to be so; and the repair having been made, the same meter will register accurately the normal consumption as before. This convinces the consumer that the fault lies in the engine and not in the meter.

Illuminating Appliance Sales.

Every industrial representative is capable of selling illumination. It has been proved that a large consumption and very many sales in all classes of industrial establishments are obtained from this part of the industrial business. Each salesman makes his own estimate of labour and material required to do the work. As has been before explained under the different headings of the paper, the practice followed at the time of making sales is to prepare a sketch for the consumer, showing just how the pipes will be run and where the lamps will hang.

This feature of sketching on paper, in order that the consumer may easily follow the explanations, is more fully developed in making illumination sales than in the other two branches of the industrial business. The sketch method permits of an adjustment of ideas between buyer and seller at the time of the sale; so that when the work is completed there can be no dissatisfaction in the results obtained.

It is here again repeated that the sketch method of making sales is one of great worth. To show that factory illumination can be obtained by an industrial division educated and developed as described in the year 1911, there were sold 1141 arcs and 10,196 reflex lights in factories. This is represented by 1421 different sales taken in 124 different trades.

Maintenance of Illuminating Appliances.

When orders are taken for illumination, it is the endeavour to secure from the consumer a signed contract for the burner maintenance of the lights purchased. It is considered to be of importance that these contracts should be obtained. Periodical visits are made to each and every factory; and at this time the lights are cleaned and the glassware and mantles replaced at a stipulated price fixed by the Company. This work is done by the maintenance division of the new business department.

New Factory Buildings.

It is the duty of a member of the division to get a service-pipe and one or more risers into every new factory building erected in the city. This is done through the architects and owners of the buildings; the member laying-out the required work for them. His work having been finished, and the building completed and ready for its new tenants, it is given over to the salesman in the district, who in turn visits the new tenants to learn what are their

needs. This practice of following the erection of new factory buildings has been productive of business which without it would have been lost.

It is also the duty of this particular department employee to follow every vacant property. Many prospects originate in this way by the employee learning of a new tenant who is about to move in, and has resulted in many sales.

Advertising.

It has been found that advertising is a great aid in promoting industrial sales. Advertising what gas will do is, as far as possible, resorted to in every manufacturing industry. This is done by the post-card and pamphlet method of write-up. These pamphlets and post-cards are written to show actual installations, cost of operation, the saving effected over the method displaced, and a testimonial letter of the purchaser. About 15,000 of these are mailed monthly to the officers, superintendent, foreman, and engineer of industrial establishments. The policy is, where possible, to send advertising matter to every person who directly or indirectly will aid the industrial gas business.

A monthly publicity organ, entitled "A Thousand Uses for Gas," is prepared and mailed, so as to acquaint the manufacturing public of the many uses of industrial gas. This mailing list is compiled with great care; and all members of the division are engaged in its perfection; for, in order to get results, it is known to be of importance to have advertising received by the right person. One or more windows are used to show appliances—say a boiler making steam, a running gas-engine, and more or less blast or atmospheric burners doing some work.

Results Obtained.

In the May, 1911, issue of "New Business," an article written by a member of the industrial division told how to get gas industrial business, replacing a coke furnace used for the hardening and annealing of metal. The price of coke was $5·50 per ton, and the price of gas was $1 per 1000 cubic feet; and the problem was to show that gas was the cheaper method. This was done as follows: To the price of coke was added the cost of the increased rate of insurance, the value of the work spoiled and of the time lost in making fires, the removal of ashes, the general inconvenience to the workmen from a dirty room, and the fact that the oven had to be prepared a half day before being used. These and like items of cost proved that the few dollars difference between the coke and its oven troubles and the gas costs *plus* gas conveniences and its greater output, was, in this case, money well invested, and resulted in a sale. This actual instance is given to show one of the many ways of getting appliance business when competing with the cheaper fuels. Here the cost of coke was not compared with the cost of gas. The last cost of each was compared—that is, the cost of each method per pound of finished output was the true comparison, which is the correct way.

The following are a few of the many instances where satisfactory results have been obtained by following the method outlined above. The Company interested a manufacturer of roller bearings in a furnace for hardening bearings, and one heating machine for this purpose was sold. At the present time, they are using nine similar machines; and, in addition, they have added forges, brazing-torches, oven furnaces—in all a total of 41 appliances. The consumption of this Company has grown in ten years to 5,740,300 cubic feet in 1911. Again, a company manufacturing steel car trimmings has five japanning ovens, 25 soldering-iron heaters, and 25 atmospheric burners for general heating. Four years ago, the first sale made to this Company was a soldering-iron heater. This consumer has been developed to use 3,167,400 cubic feet of gas per annum. A certain large candy manufacturer uses sixteen blast candy-stoves, consuming some 1,476,700 cubic feet of gas a year. This piece of business was obtained from a small beginning, by a trial installation converting a coal-stove to use gas. It took two yearsto build up this business. From the usual small beginning another manufacturer has been developed in like manner, and now has twenty-six gas-heated candy-stoves; the annual consumption of gas being 3,247,100 cubic feet.

Many cases like the following could be related of the development of large consumers: A locomotive plant began using gas before the organization of the division, and therefore it is not known how small was their beginning; but, under the methods as outlined in the paper, the consumption increased from 4,981,000 cubic feet in 1910 to 5,478,000 cubic feet in 1911. In a steel-mill, it rose from 8,250,000 cubic feet in 1910 to 15,689,000 cubic feet in 1911; in a factory making finished castings, from 4,981,000 cubic feet to 5,478,000 cubic feet in the same time; in a company manufacturing storage batteries, from 4,550,500 cubic feet to 6,893,900 cubic feet; and in a manufacturer of electroplates, from 6000 cubic feet in January, 1912, to 85,000 cubic feet in October, 1912.

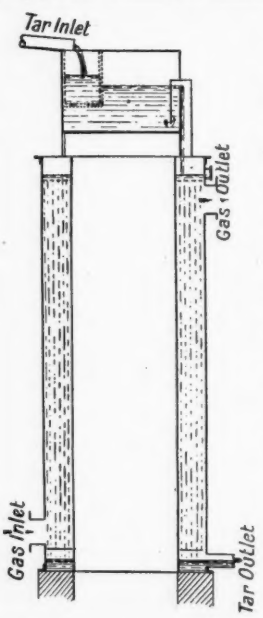
In 1910, the industrial division sold 61 million cubic feet of gas through the sale of factory appliances, 37 millions through the sale of gas-engines, and 10 millions through the sale of illuminating appliances—making a total for the year of 108 millions. In the year 1911, there were sold 74,738,785 cubic feet of gas through the sale of factory appliances, 28,420,030 cubic feet through the sale of gas-engines, and 27,263,900 cubic feet through the sale of illuminating appliances—making a total of 130,422,715 cubic feet. In 1912, to date, on these items the sales are about the same as those during a like period in 1911.

It is believed that the methods of procedure for getting industrial appliance business here outlined and described are correct, not only for the large, but for the small, situation. If a situation will not admit of the employment of more than one man, he can be developed into a competent industrial representative, as the term is understood and here explained—that is, not only can he be developed to make sales, but also to inspect and repair appliances, gas-engines, and be his own factory building inspector.

CRUDE TAR FOR COOLING AND CLEANSING CRUDE COAL GAS.

Herr A. Beuthner, the Works Superintendent at the Brunswick Gas-Works, describes in the "Journal für Gasbeleuchtung" for April 12 experiences which he has gained in the use of crude tar for cooling and washing coal gas. He observes that while ordinarily the tar is taken in the most direct manner to the tar-wells where it acquires the temperature of the ground, yet on account of its high specific heat, it is more suitable than liquor for cooling crude gas, and, on account of its composition, it should be capable of effecting considerable purification of the gas. The hot summer of 1911 was productive of many naphthalene obstructions in the distributing system. Atmospheric condensers became ineffective, and while the duty of extracting the whole of the naphthalene was thrown upon the naphthalene washers, the high temperature of the gas entering the latter caused much liquor to be deposited in them. The liquor thus deposited interfered with the action of the oil in the washers. The author then endeavoured to cool the crude gas before it entered the atmospheric condenser by means of a finely-divided stream of tar; and the result was better than he had anticipated. He used an annular condenser for the purpose. He erected on top of it a tank with a screened inlet for tar, to which the tar was pumped by a rotary pump from the tar-well. The tar flowed from the tank on to a distributor in the top of the condenser, and thence fell in finely-divided streams to the bottom of the condenser, up which the hot gas was passing in the reverse direction to the tar spray. Intimate contact between the latter and the gas was thus attained; and the sudden cooling of the crude gas produced from it a tar fog which, with the tar introduced, carries away from the gas almost the whole of the naphthalene, a great part of the carbon bisulphide, and some of the sulphuretted hydrogen. Most of the tar was extracted from the crude gas at the same time. The distributor had to be adapted to the quality of the tar used.

Before this tar condenser was introduced, from 6 oz. to 8 oz. of washing oil was used in the naphthalene washers per 1000 cubic feet of gas dealt with, whereas after the tar condenser was used 0·0625 lb. of washing oil sufficed. The effect of the tar treatment of the gas may be realized from the fact that the thick tar and naphthalene which had previously been deposited in the atmospheric condenser, tar-extractor, and connections were removed in a short time by the gas which had passed through the tar condenser. Further, a slimy layer was no longer formed on the surface of the water in the "Standard" washer, and obstruction of the wood bundles, and consequent increase of pressure, was thus avoided. With the arrangement adopted by the author (which is shown in the illustration) nearly a gallon of tar is required per minute in order to cool 1000 cubic feet of gas from 122° Fahr. to 86 to 95° Fahr. The temperature of the tar in the tar-well, which is a small one, becomes as high as 77° Fahr. in summer. The tar becomes thinner and more valuable as a result of its use in the tar condenser. A favourable, rather than a bad, effect has been observed on the illuminating power and calorific value of the gas treated.



The use of a tar condenser in the manner described has been patented in Germany by Herr Beuthner.

Natural Gas at Neuengamme, Hamburg.

From the "Journal für Gasbeleuchtung" for the 19th inst. we learn that such progress has been made with the springs of natural gas at Hamburg, that it will be used for industrial purposes in the near future. The gas as it issues from the source is first to be reduced from about 30 to 6·5 atmospheres, and will then be taken to the Tiefstack Gas-Works through a 10-mile main. Thence it is to be distributed to the several other works at various pressures. At the first regulator, which reduces the gas from the high natural pressure down to 6·5 atmospheres, there is to be a special heating arrangement to counteract the fall in temperature due to the expansion of the gas. The German journal promises a further reference to the subject, with a detailed description of the plant when it comes into action.

NOTES ON COAL GAS MANUFACTURE.

By A. L. Evans, of Woolwich.

At a Meeting of the Graduates' Association of the Institution of Mechanical Engineers held on Monday of last week, a paper entitled "Some Notes on Coal Gas Manufacture" was contributed by Mr. A. L. Evans, of the Woolwich Arsenal Gas-Works. The chair was taken by Mr. Harry E. Jones, M.Inst.C.E.

In preparing the paper, the author had to take into consideration the fact that the majority of his audience were students in other branches of engineering, with only a surface knowledge of general gas-works practice. Consequently, he confined his remarks to the elementary principles of the subject—tracing the process of gas-making, and explaining the function of the plant and apparatus by the aid of lantern slides and diagrams. The paper opened with a reference to the extended use of gas for heating, cooking, and industrial purposes, and statistics were given showing the increased production for the past eleven years to be nearly 27 per cent. The various types of coals, and their use for gas-making purposes were then dealt with, and the theory of carbonization was briefly but clearly explained. An original lantern slide which attracted much attention was a working section of a two-blade exhauster. Space was found for explaining the various systems of setting retorts; the author's opinion being that, as regards gas made per ton of coal, verticals are superior to other types of retorts. The paper concluded with a general reference to methods of purification, measurements, and storage.

In inviting discussion, the Chairman congratulated Mr. Evans on an informing paper which showed a close knowledge of the subject, and which would form a valuable *vade mecum* to engineering students in the course of their visits to gas-works. A brisk discussion then followed, particular interest being displayed in the production of hydrogen for ballooning purposes, and the possibilities of benzol. In bringing the proceedings to a close, Mr. Jones briefly traced the remarkable development and progress of gas from the time of Murdoch to the present day. He instanced the gradual change of gas from lighting to heating purposes, and spoke of the enormous growth of slot-consumers, particularly in the east end of London. With regard to the question of vertical retorts, the Chairman stated that some 35 years ago he mentioned in a paper read before the Institution of Civil Engineers that gravitation was the ideal system to employ for charging and discharging retorts. At the present day, however, there were many horizontal installations under his care which were giving more gas per ton than any vertical system.

After a brief reply by the author, the proceedings terminated.

ANALYSIS OF CLAY.

A "Rational" Method.

In the course of a paper on "The Physical Properties of Clays," read by Mr. W. C. Hancock, F.I.C., at the Royal Society of Arts last Wednesday, he pointed out that ultimate chemical analysis alone gives very little information as to the working properties of a clay. Clays are, in fact, not definite chemical compounds, but complex mixtures of different minerals. A chemical method of examination has been worked out, which aims at separating the main mineral constituents into three groups. It is known as "the rational analysis;" and it was described by the author as follows: "Briefly, it consists in treating a weighed portion of the clay with strong sulphuric acid, which decomposes the hypothetical clay substance, the alumina of which is converted into aluminum sulphate, while the silica is liberated in a condition in which it can be easily dissolved in solutions of alkali or alkali carbonates. The residue left after treatment with these reagents is weighed, and the 'clay substance' calculated by subtracting this weight from that of the clay taken. The insoluble residue is assumed to consist of quartz and felspar. The amount of the latter is calculated from the amount of alumina or alkali present, and the quartz obtained by difference. Without discussing the merits or defects of the method, the original clay is separated into three constituents—viz., clay substance, quartz, and felspar—which are the main constituents of pottery bodies. When a new clay has to be substituted for another in a body mixture, from the results of a rational analysis the changes that must be made in the mixture, in order to retain the same proportions of the three ingredients, can be calculated. In addition, certain predictions as to the working qualities of a clay can also be made. For example, a high proportion of clay substance indicates a plastic clay. Clays with large amounts of quartz do not tend to contract so much as those with smaller amounts; and a large amount of felspar points to a fusible clay."

Gas-Pipes Fused by Lightning.—During a thunderstorm at Burton last Thursday, the lightning struck and broke insulators on the tramway standards, and stopped the service for half-an-hour. Lightning also entered two adjoining houses on the Branstone Road and fused some gas-pipes. The gas escaped and became ignited, causing a large flame in each house for several seconds. Fortunately, little damage was done.

CORRESPONDENCE.

[*We are not responsible for opinions expressed by Correspondents.*]

An Experience with "Metro" Gas-Burners.

Sir,—I desire to acknowledge your contributor's handsome reference to the "Metro" burner in the current issue of the "Journal" for the purpose of making two other acknowledgments. The first is to Mr. D. Chandler, who is in charge of our experimental laboratory, and whose painstaking endeavours have so largely contributed to the successful working-out of the burner design. The second is to Mr. C. W. Kemp, of the firm of Messrs. Ingram and Kemp, whose assistance has been invaluable in making the arrangement a commercial possibility. The fittings manufacturers of Birmingham laughed at us when, some dozen years ago, we approached them on the subject of artistic gas-fittings. "Gas-fittings!" said they. "Why gas is moribund! All the fittings the public want can be bought from the local ironmonger." Mr. Kemp, however, gave us a sympathetic ear; but that is another story. I had started to express our gratitude to him for his invaluable aid in the manufacture of the "Metro" burner, and cannot let pass this opportunity without publicly doing so.

May I conclude with a word or two of explanation? When we began to build-up the gas-using section of our business, I gave to our staff as its precept: "Take care of the lights, the stoves will take care of themselves." Then, as now, I believed in our lighting load as the backbone of our business; and we have never ceased to labour with this end in view. When the vogue of the inverted burners began, I tried various kinds—British and foreign, modest and advertised—and soon came to the conclusion that vital improvement must be made if they were to come to stay. Only a gas man could be expected to accept unmoved the not-infrequent remark, on returning home at night, "Can you *do* the kitchen light? Cook can't see to fry."

Variable gas and air supplies may be all very well for manufacturers who desire to stock one grade of article for distribution all over the kingdom. They may be all very well for gas undertakings who look no farther than their gas-making plant, and console themselves for any irregularity in the gas they produce by the reflection that their customers' burners are adjustable. But the future is not for them. All that should be necessary to the consumer for obtaining or varying his supply of light and heat is a tap—one of the most remarkable, and at the same time simple, mechanical devices that has ever been invented. That is the ideal we should seek; and I believe in its attainment.

Charles Carpenter.

South Metropolitan Gas Company, April 18, 1913.

Artificial Rubber.

Sir,—On p. 84 of the issue of the "Journal" for April 8, an account is given of a paper by M. Gouvy, on the subject of artificial rubber.

In this account it is stated that "rubber consists mainly of a hydrogen carbide, most complex in composition—viz., isoprene, the simplest form of which is butadeine."

As a matter of fact, rubber does not consist of isoprene. Isoprene is not complex in composition; butadiene (which is presumably the substance meant by "butadeine") is not a form of isoprene.

Isoprene is a hydrocarbon, boiling at 37° C., with the formula C_5H_8, which is converted by the action of sodium into a substance closely resembling, if not identical with, natural rubber. It can be made in a variety of ways. Butadiene has the formula C_4H_6, and can be converted into a substance closely resembling natural rubber.

G. W. F. Holroyd.

Shoreham, Sussex, April 17, 1913.

The Discussion on Mr. Trotter's Paper.

Sir,—Referring to the discussion of Mr. A. P. Trotter's paper, on "Standard Clauses for Inclusion in a Specification of Street Lighting," presented at the meeting of the Illuminating Engineering Society on Tuesday last, in which the four Societies represented on the Joint Committee are taking part, will you in your next issue be so good as to direct special attention to the fact that the discussion was adjourned to 7.30 p.m. on Tuesday, the 29th inst., and that the members of the Institution of Gas Engineers are invited to attend. The meeting takes place at the Royal Society of Arts, John Street, Adelphi.

Copies of the paper may be obtained from Mr. Leon Gaster, the Hon. Secretary of the Illuminating Engineering Society, 32, Victoria Street, Westminster, S.W., to whom those intending to speak in the discussion are requested to send their names.

Walter T. Dunn, Secretary Institution of Gas Engineers.

39, *Victoria Street, S.W., April 17, 1913.*

Alliance and Dublin Consumers' Gas Company.

Sir,—In reference to the criticism of "Nonulus" in your last issue, it is to be hoped, for the critic's reputation, that his other points are stronger than the second; for it appears to me that the difference in the figures he mentions is simply the income-tax which has been deducted from the interest on the debenture stock.

Accountant.

Wrexham, April 19, 1913.

Use of the Steam-Roller for Reinstating Roads.

Sir,—My company are periodically troubled by the district council in regard to the maintenance of roads after being opened for repairs, &c. Quite recently, we received a communication from them to the effect that the surveyor had informed them that he was of the opinion that the roads could not be made good after such opening without the use of the steam road-roller; and therefore the council intimated that

in future they will insist upon the roads being made good, and, where necessary, the steam road-roller will be used at our expense.

Now, I submit that there are no grounds whatever for the complaints made. Of course, the company acknowledge their liability to make good the roadway, and maintain it for the statutory period, in accordance with the Water-Works Clauses Act. But our contention is that there is no authority or precedent for the course of action suggested by the council; and we do not intend to defray any expenses incurred in this manner.

My object in writing is to learn whether you or any of your readers are aware of a precedent bearing upon our case.

ROCHDALE.

April 18, 1913.

The "Wandering Tinker."

SIR,—Mr. H. E. Jones should verify his quotations. I note from his speech as Chairman of the Bombay Gas Company, reported in this week's "JOURNAL," that he fathers on Laurence Sterne the "Wandering Tinker" (the "Needy Knife-Grinder"), and his reply when asked for his story, "Bless you, sir, I have no story to tell." The incident is from the "Anti-Jacobin;" and its author was Canning, the distinguished Statesman and whilom Prime Minister.

VERO.

April 16, 1913.

REGISTER OF PATENTS.

Automatic Supply of Gas Intended to Furnish Hot and Cold Water for Domestic Use.

NICOUD, J. D., of Paris.

No. 4618; Feb. 23, 1912.

This invention relates to apparatus for controlling the gas supply to the burners of water heaters or geysers, of the type in which the gas-valve is opened automatically, by water admitted to a piston which operates the gas-valve when the water-supply tap is turned on—only one cock and one conduit being employed.

The invention consists essentially: First, of a valve mounted on the water-conduit and comprising a case provided with four orifices, in which a stopper or obturator moves a shaft on which are also mounted a second obturator and a piston. The valve is furnishing water to the passage communicating with the gas-valve operating chamber when the water-cock is opened to a certain extent, and prevents the supply of the water at the passage when the cock is fully opened or entirely closed. Second, of a gas-valve comprising a cylindrical and conical portion which is actuated by a piston rod, itself actuated by the water furnished by the water-conduit. Third, of a safety pipe intercalated between a blow-off pipe and the valve mounted on the water-conduit.

The apparatus is placed on the water-service conduit so that normally one of the obturators of the water-valve closes the passage controlling the gas-valve. When the cock is opened to a certain extent, the obturator opens the passage so as to actuate the gas-valve to supply the gas and furnish hot water; while, if the cock is entirely opened, the other obturator closes the passage and the gas-valve drops on its seat, so that cold water runs through the heater without being warmed. The heater has only a small light or pilot flame.

Charging and Discharging Gas-Retorts.

LAKE, W. R.; a communication from the RITER-CONLEY MANUFACTURING COMPANY, of New Jersey, U.S.A.

No. 6898; March 20, 1912.

This apparatus for charging and discharging retorts is of the kind in which a number of scoops containing coal are advanced into the retort and thereupon reversed to empty their charge of coal into the retort.

The reversing mechanism comprises a segment having a rack on each face with which gear-wheels upon the scoop shafts engage; the segment being adapted to be rotated upon the completion of the forward movement of the scoops to reverse them. As an alternative, the scoop shafts may be provided with intermeshing pinions—the turning and reversal of the scoops being accomplished by the rotation of one of the shafts by means of a belt pulley thereon, driven through interconnected belt pulleys from an electric motor; the carriage carrying the scoops being propelled by a second electric motor.

The invention is fully described with reference to a long series of accompanying drawings. The patentees remark that: "It will be understood that the invention relates to the scoop reversing mechanism only, and that the whole apparatus is merely illustrated to provide a better understanding of the scoop reversing mechanism."

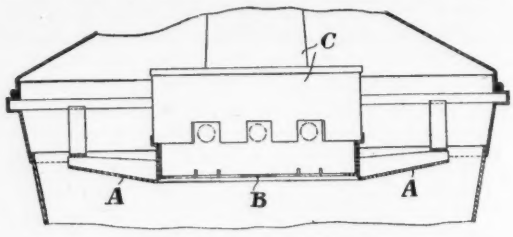
Incandescent Gas Street Lamps.

SPARKS, E., of Tufnell Park, N.

No. 7310; March 26, 1912.

This invention relates to outdoor lamps, with the object of enabling lamps of ordinary construction to be "adapted, with a minimum of alteration, for use with practically any desired number of inverted incandescent gas-burners."

As shown, the body or framing of the lamp, "constructed in a manner common in street or outdoor lamps," is provided with the reflector of the present invention. This consists of a dished plate A supported by metal strips to the framing of the lamp. This main part of the reflector is formed with a central opening of circular shape, provided with an upstanding flange. The opening is closed by means of a plate B, formed with openings corresponding in number to the burners with which the lamp is to be provided. The plate is made of box section, and preferably with a horizontal lip or flange, which rests (when the plate is placed in position) on the upper edge of the upstanding flange formed on the plate. The hinged roof of the lamp is secured in its lowered position by a catch or bolt; and the products of combustion escaping round the burner apertures in the plate B are led



Sparks' Street Lamp Lantern.

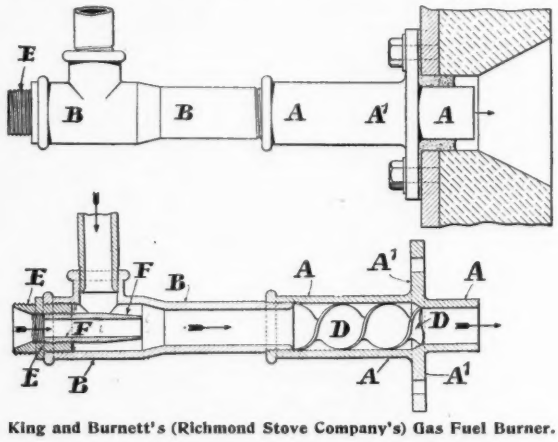
away to a wind-proof hood by means of a sleeve or uptake C, formed with cut-away parts for the accommodation of the burners and resting, when the roof is in position, on the horizontal lip or flange of the plate B. Both parts of the reflector are provided with reflecting surfaces.

Gas Fuel Burners.

KING, J., BURNETT, J. R., and the RICHMOND GAS STOVE AND METER COMPANY, of Warrington.

No. 8284; April 6, 1912.

This burner, for use with tool hardening, forging, crucible, annealing, and like furnaces, is a blast-burner with its parts arranged as shown.



King and Burnett's (Richmond Stove Company's) Gas Fuel Burner.

It consists of a tubular chamber, preferably in two parts. The forward end of the part A (which forms the nozzle) extends beyond the flange A¹, and at this point is made of smaller diameter, "thus producing a tapered or inclined surface." A spiral D (of known type), having two to three convolutions, is placed in the larger interior, so that one end bears against the inclined part. Behind the spiral, and screwing into the part A, is the part B which holds the spiral in position. At its rear end it is fitted with a union E, carrying an air nozzle or injector F; the union being connected to "any suitable source of air supply." The position of the gas inlet opening G relatively to the air-nozzle F is such that the latter projects into the part B, the interior of which, around the nozzle, is also, by preference, larger in diameter than the part extending towards and connecting the part A—thus producing an inclined or tapered surface, so that the gas will be directed down to meet the incoming air, and thus it becomes partly or wholly mixed with it. On the mixture coming into contact with the spiral D, it will, if not mixed prior to reaching, become thoroughly intermixed; the spiral and inclined surface serving to baffle and subdivide the mixture.

With such burner, it is said that a bunch or ball of flame is produced which is "more effective than a conical or tapered flame."

Atmospheric Gas-Burners.

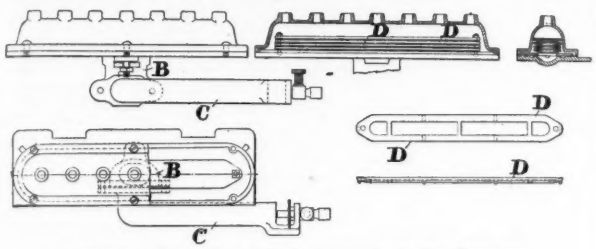
FLETCHER, RUSSELL, AND CO. and FLETCHER, T. W., of Warrington.

No. 28,550; Dec. 11, 1912.

This is an improvement of the atmospheric gas-burners described in patent No. 25,979 of 1908, in which a chamber is provided between the mixing-chamber and the nozzles by means of a diaphragm that is separate from the main portion or base of the burner, and is formed with a succession of transverse slits, through which the mixture of gas and air passes into the chamber between the diaphragm and the nozzles and thence to the nozzles—the ends of the diaphragm fitting over the outlet apertures of the mixing-chamber. The object of the present invention is "to simplify the construction of the diaphragm, and thereby effect a saving in labour."

The diaphragm is made of separate plates D, placed one on the other—each formed with longitudinal apertures and with small projections to keep the plates apart when placed one on the other. The side edges of the plates are preferably turned up at an angle. The required number of superposed plates are placed in position with corresponding apertures, and are then fastened together; while the bottom plate is

secured at each end to the base of the burner by bolts or screws. The gas and air entering the tube C passes into the apertures B in the base through the spaces between the plates D, and is diffused along the chamber between the plates and the nozzles, passing from the chamber



Fletcher, Russell, and Co.'s Atmospheric Gas-Burners.

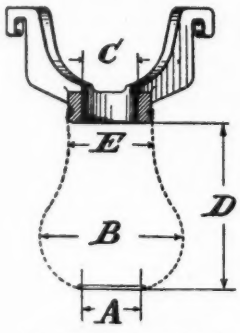
to the nozzles. By these means, the labour required for cutting the transverse slits in the diaphragms as described in the earlier specification is avoided, and the number of plates may be varied to suit various sizes of burners.

Incandescent Mantles.

LANGHANS, R., of Berlin.

No. 28,496; Dec. 10, 1912. Convention date, March 1, 1912.

This invention is a modification of patent No. 28,091 of 1912—see *ante*, p. 107. It relates to a pear-shaped mantle with rodless ring suspension, with the burner-tube entering the mantle centrally. While hitherto the mantles for such "upright-hanging" gas-burners, the patentee remarks, have been suspended on the burner-tube or a support carried by the latter, in the earlier patent the suspension of the mantle without the use of a rod is described by suspending it from the glass chimney or the like, "because such a method of suspension presents the great advantage that no supporting rod need be provided in the interior of the mantle, neither need the burner-tube be continued therein; so that the interior of the mantle is entirely free, and there is no light or heat abstracting body in the interior of the mantle." If, however, in such cases the mantle is made of the usual form and dimensions for inverted gas lighting, the defect arises that the flame contracts above, and consequently does not impinge upon the fabric of the mantle—"the result being defective utilization of the luminous power." The form usually adopted for these mantles is cylindrical, with a hemispherical rounding-off at the bottom, where the opening for the introduction of the slotted burner-head is provided—the diameter of the lower opening being determined by the diameter of the burner tube "which it should surround as snugly as possible in order to avoid prejudicial air admission at this place."



Langhans' Pear-Shaped Mantle.

Experiments have demonstrated, the patentee says, that a pear-shaped mantle for rodless upright-inverted lights only utilizes the luminous power to the full when there is an exactly predetermined ratio between the height—that is to say, luminous length—of the mantle and of the maximum diameter of the pear-shaped body to the internal diameter of the mantle ring which corresponds to the diameter of the burner-tube. The illustration shows such a mantle in the natural proportions. The upper small diameter E is determined by the consideration that, for practical reasons of manufacture, the mantle-ring cannot be made with a wall of less than a certain thickness. If the gas pressure is greater or smaller, the length D and the maximum diameter B of the pear-shaped part of the mantle must be modified, while the dimension C of the mantle-ring and the diameter A of the opening in the bottom of the mantle remain the same. If this form and these dimensions are observed, "the luminous power will be fully utilized, while the power at once falls if the form and dimensions are departed from."

Gas Profits at Morecambe.—At the meeting of the Morecambe Town Council last Tuesday, the Chairman of the Finance Committee (Alderman Snowden) stated that last year the Gas Committee provided £800 in relief of the rates, and this year they proposed to hand over the whole of the profits, amounting to £1800. Most of the Committees, he said, had exceeded their estimates; but the Lighting Committee was an exception. For a number of years the Gas Committee had not expended a penny on capital account, but a great deal had been spent out of revenue.

The Koppers Ovens at Saltley.—In an article on the Koppers coke-oven installation at the Saltley Gas-Works, the "Birmingham Daily Mail" points out that the grey furnace coke produced differs in several important features from the ordinary gas-coke, which is the residual of the usual process of carbonizing coal for gas purposes, and is of much greater commercial value. To-day, gas coke is selling at 16s. a ton; whereas grey furnace coke, which is in demand for smelting and other important industrial purposes, is worth 25s. a ton. It is added that in the preparation of the coal for the ovens more labour is required than in the case of the production of ordinary gas coke; but taking it altogether, the extra cost of making the furnace coke on the system in operation at Saltley is not proportionately as great as the increased value of the coke over gas coke, thus leaving a satisfactory margin of profit.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF LORDS.

The following further progress has been made with Bills:—

Bills brought from the Commons and read a first time: Coventry Corporation Bill, Crowborough District Gas and Electricity Bill.

Bill read a second time and committed: Leeds Corporation Bill.

Bills reported: Northampton Corporation Water Bill, Slough Gas Bill, South Staffordshire Mond Gas Bill, South Staffordshire Water Bill.

Petitions against the Bradford Corporation Bill have been presented by the Drighlington, Gildersome, and Hunsworth Urban District Councils.

The opposition to the Aberystwyth Corporation Bill has been withdrawn.

The Bradford Corporation Bill, Llantrisant Gas Bill, and West Hampshire Water Bill have been referred to a Select Committee, consisting of the Marquis of Bristol (Chairman), the Earl of Craven, Lord Plunket, Lord Monteagle of Brandon, and Lord O'Hagan, who commenced sitting yesterday.

HOUSE OF COMMONS.

The following further progress has been made with Bills:—

Bill reported: Herne Bay Gas and Electricity Bill.

Bills read the third time and passed: Crowborough District Gas and Electricity Bill, Harrow and Stanmore Gas Bill.

The petitions of the East and West Ashford, Hollingbourne, and Maidstone Rural District Councils, and the Maidstone Board of Guardians against the Mid Kent and East Kent District Water Bill have been withdrawn.

MYNYDDISLWYN URBAN DISTRICT COUNCIL BILL.

HOUSE OF COMMONS COMMITTEE.—Wednesday, April 16.

(*Before Mr.* GARDNER, *Chairman, Mr.* SAMUEL, *Mr.* LAMBERT, *and Mr.* INGLEBY.)

The object of the Bill is primarily the acquisition of two gas undertakings within the area of the Mynyddislwyn Urban District Council—namely, those of the Bedwellty Urban District Council and the Risca Urban District Council.

Mr. F. N. KEEN (who appeared for the promoters), in opening, said the whole district of the Mynyddislwyn Urban District Council was in Monmouthshire. It was formed into an urban district in 1903. Its prospects of future development were very great. The area extended to over 5000 acres, and had plenty of room to expand. There were two large collieries in the district. Most of the houses were inhabited by colliers; and the great bulk of the gas supply was by slot meters. With regard to the purchase of the Risca gas undertaking, the authorities had been in negotiation for a long time, and had almost come to an agreement. As, however, there were a few small points still outstanding, Counsel proposed that the gas part of the Bill should be deferred until the following morning, when he hoped to be able to present the sealed agreement to the Committee.

Thursday, April 17.

On the resumption of the proceedings this morning,

Mr. KEEN explained that there were in effect three gas suppliers in the Mynyddislwyn district—viz., the Bedwellty Urban Council, the Risca Urban Council, and the Rhymney and Aber Valleys Gas and Water Company. The latter had, under an old Act of 1898, the power to supply in bulk in any area adjoining their own. They could thus give a bulk supply in the Mynyddislwyn district. The Abercarn Council also, under an Act of 1902, had powers to supply in any part of the Mynyddislwyn district; but they did not actually supply. Under the Bill, therefore, it was proposed that the powers of the Abercarn Council should be repealed, and the Mynyddislwyn district cut out from their supply. It also proposes to limit the Rhymney and Aber Valley Company's powers so that they could not supply in the Mynyddislwyn district without the consent of the Council. Further powers were sought in the Bill to buy up the Bedwellty and Risca undertakings. The present price of gas in Bedwellty was 4s. 9d. per 1000 cubic feet to ordinary consumers, with, of course, something higher for slot consumers, and 4s. 6d. in Risca. The coal was not obtained from the collieries near at hand, as that was steam coal, but came from quite a long distance. Counsel maintained that the undertakings would be more economical and convenient under one management, and that the promoters would be able to carry on the concern entirely for the benefit of their own people. The Bedwellty Urban District Council obtained their undertaking, under the powers conferred by an Act of 1912, by transfer from the Blackwood Gas Company. This Company had existed for a great many years, and was converted into a statutory concern by an Act of 1909. In that Act the Bedwellty and Mynyddislwyn Councils obtained a clause under which, either jointly or separately, they might purchase the whole undertaking within a period of twenty years. The Bedwellty Council subsequently promoted a Bill separately for buying the whole undertaking of the Blackwood Company. They first promoted it in 1911, and it went down on Standing Orders. In 1912, it was again promoted and went through. The Mynyddislwyn Council opposed the 1912 Bill, on the ground that they had the right to purchase, under the Blackwood Act of 1909, the portion of the undertaking in their area; but an agreement was afterwards come to. They got a clause inserted in the Bill whereby, if they

promoted a Bill during the next two available sessions, the Bedwellty Council were not to oppose it if it came forward in accordance with terms set out in the clause, which was as follows:

> The Council shall pay to the Bedwellty Council as the consideration for the transfer of the Northern gas undertaking: (*a*) The sum of £2705. (*b*) A sum equal to the actual expenditure (if any) by the Bedwellty Council on the provision of new gas mains, pipes, and other works within the gas limits of the Council between the 7th day of August, 1912, and the Bedwellty date of transfer, such expenditure to be determined, in default of agreement, by arbitration under this section. (*c*) Interest on the aforesaid sums (*a*) and (*b*) at the rate of 4 per cent. per annum from the Bedwellty date of transfer to the date of payment of such sums respectively.

Mr. JONATHAN SAMUEL (a member of the Committee) asked Counsel why one gas-works could not be erected to supply the whole of the three areas.

Mr. KEEN explained that the areas were in quite different valleys, and the mains and pipes could not be laid owing to engineering difficulties. As a matter of fact, the Bedwellty Council had actually two gas-works for supplying different parts of their area on account of these difficulties. He then proceeded to give a brief history of the Risca undertaking. The Urban District Council acquired the concern in 1909. It was originally in the hands of the Western Valleys Water and Gas Company; but in 1909, the Risca Council bought up both undertakings. In that year they asked the Mynyddislwyn Council to join them; but the latter thought that, in view of engineering difficulties, it was not advisable. However, terms were arrived at and incorporated in the Bill, to the effect that if the Risca Council did not supply in the part of the Mynyddislwyn district provided in the Bill, their powers were to cease. The Mynyddislwyn Council also obtained a purchase clause, which provided that, if they came for powers to purchase within three years, the Risca Council might not oppose the principle of purchase—they might only oppose on details asking that the following three conditions were complied with: (1) That the Mynyddislwyn Council must give the Risca Council not less than two years' notice of their desire to purchase their portion of the undertaking, including goodwill, after the expiration of three years; (2) that they must obtain the consent of the Local Government Board to purchase; and (3), that they must apply, either to Parliament or the Local Government Board, for powers to purchase. On Aug. 17, 1912, the Mynyddislwyn Urban District Council gave notice to the Risca Urban District Council of their desire to purchase. They then promoted the present Bill, and applied to the Local Government Board for consent. The Board would not consent, however, unless a local inquiry was held; but they eventually satisfied the Board that a local inquiry was not necessary, and so came to Parliament. A purchase price of £16,308 had been agreed between the Mynyddislwyn and the Risca Councils, with the same provisions as in the case of Bedwellty as between March 31, 1913, and the transfer day. There was also an agreement that Risca should give a bulk supply to the Mynyddislwyn Council for a period of seven years (the amount not being less than 7,000,000 cubic feet per annum), at a price of 3s. per 1000 cubic feet, provided that if there was any trouble as to strikes, &c., which caused the suspension of supply, the minimum quantity of gas to be taken from the Risca Council should be in proportion to the percentage of the time of suspension to the year—*i.e.*, if the supply was suspended for a month, the quantity of gas to be taken would be 7,000,000 cubic feet, less one-twelfth. The Risca Council could supply any large undertaking in the Mynyddislwyn district in bulk. Counsel maintained that within two or three years it would probably pay the promoters to construct their own gas-works as far as the portion now supplied by Risca was concerned. They could then make their own gas beyond the 7,000,000 cubic feet until the seven years expired, and then manufacture all their gas. They could use any pressure provided it did not exceed 6 inches.

Mr. *Frank Jones*, who advised the promoters with regard to the gas portion of the Bill, stated that there was a fairly large demand for gas at present, and this was expected to increase rapidly. There were still about 300 or 350 consumers in the whole district proposed to be taken over by the promoters waiting to be connected at the present time.

The CHAIRMAN asked why, instead of dropping suddenly the 7,000,000 cubic feet supplied in bulk by the Risca Council at the end of seven years, the supply could not be stopped by degrees.

Witness said he did not think this would be very advantageous to the Risca Council, because their supply would be gradually increasing—and 7,000,000 cubic feet was not a particularly large quantity. He thought that in a few years the Risca Council would supply more gas outside their area than inside. He did not urge the Mynyddislwyn Council to construct new works just yet.

Mr. *William S. Nash*, J.P., the Chairman of the Mynyddislwyn Urban District Council, stated that he did not think there would be any deficit after the first year; but there might be during the first year of working. He was satisfied that the proposal of the Bill was a desirable one in the interests of the locality. In course of time he anticipated the undertaking would be remunerative, and the price of gas would be reduced. This he accepted from experts.

Clause 43 of the Bill, dealing with gas-fittings, was, at the promoters' own desire, framed after the model clause in Electric Lighting Orders. It read as follows:

> 1.—The Council may purchase, sell, let for hire, fix, repair, and remove, but shall not manufacture, engines, stoves, ranges, pipes, and other fittings for lighting, motive, heating and ventilating, cooking, or any other purposes, and may provide all materials and work necessary or proper in that behalf, and with respect thereto may demand and take such remuneration or rents and charges, and make such terms and conditions, as may be agreed upon.
>
> 2.—The Council may enter into contracts for the execution of any of the powers of this section, and shall not themselves lay any pipes on the consumers' premises except between the main of the Council and the consumer's meter, nor shall they sell any such gas-fittings as aforesaid, except through a contractor. Provided as follows: (*a*) The Council shall so adjust the charges to be made by them for any such fittings, or for the fixing, repairing, or removal thereof, as to meet any expenditure by them under the powers of this section in connection therewith (including interest upon moneys borrowed for those purposes and all sums applied to sinking fund for repayment of moneys so borrowed. (*b*) Every sum charged by the Council in respect of the provision of such fittings, or the fixing, repairing, or removal thereof, shall be separately stated on every demand note delivered by the Council to the consumer. (*c*) The total sums expended and received by the Council in connection with the purposes in this section mentioned in each year (including interest and sinking fund) shall be separately shown in the published accounts of the gas undertaking of the Council for that year.

The preamble was then proved, and the Bill ordered to be reported for third reading.

The parliamentary estimates in connection with the undertaking are:

Purchase of land and easements	£1,150
Works, condensers, exhausters, boilers, purifiers, gas-holder, siding, &c.	11,150
The laying on to extra consumers—viz., services, meters, stoves, &c.—in addition to those existing in the area . .	5,080
Extension of mains (in addition to those existing in the area)	7,520
	£24,900

BLYTH AND COWPEN GAS BILL.

The promoters of this Bill have deposited a petition for leave to introduce an additional provision into the Bill deposited earlier in the session. It has been formally held not to comply with Standing Orders owing to late notice, and will come before the Standing Orders Committee to-day. The additional provision merely changes the name of the Company from the Blyth and Cowpen Gas Company to the "Blyth Gas Company."

SOUTH STAFFORDSHIRE WATER BILL.

This Bill, the object of which is to confer power upon the South Staffordshire Water Company to construct works and raise additional capital, was recently considered by a Select Committee of the House of Lords, presided over by the EARL OF PLYMOUTH.

Mr. CLODE, who appeared for the promoters, said the Company was incorporated in 1852. The area of supply was 50 miles long and 20 miles broad; and it was important that the water-bearing strata should be preserved intact. Last year the Company supplied 142,541 consumers. There was no legitimate opposition to the Bill. It was only fair to say that, out of twenty opponents, nineteen had been advised by their Parliamentary Agents to withdraw; and the only one left was Sutton Coldfield. At one time the promoters contemplated sinking wells, which Sutton Coldfield thought would be injurious to it, and consequently the idea had been abandoned. No injury could now be done, and no allegation of injury could be made. He therefore asked the Committee to say that Sutton had no *locus* to be heard against the Bill.

Mr. RAM submitted that Sutton was entitled to *locus* with regard to grievances which were outside the question of the wells. The promoters proposed to construct new works, and take water from the immediate neighbourhood of Sutton. The petitioners were asking to be allowed to purchase the portion of the water undertaking which was inside their area. Sutton ought to be able to buy on full compensation terms, and should be in a position to supply water to the town. These were matters he desired to go into if the Committee decided that he had *locus standi*.

The Committee decided that Sutton had a right to be heard on the question of purchase.

Mr. *F. H. Lloyd*, the Chairman of the Company, was examined in reference to the proposals of the Bill. He said that in the last twenty years there had been an increase of 64,447 in the number of water consumers. There was no analogy between the cases of Sutton and Quinton; the latter being a very small agricultural area, equal to a small part of the Company's undertaking. On the other hand, Sutton Coldfield was a large and thickly populated area, contributing in water-rates to the Company a sum of £7000 a year. It was impossible, therefore, to argue that, because Quinton was taken over by Birmingham under an agreement, therefore Sutton should be allowed to come out of the Company's area of supply. If the Company were to part with such districts as Sutton, their position would become untenable.

Cross examined by Mr. RAM, witness said he was confident that the Sutton inhabitants could not provide their own water supply better than it was now being provided by the Company.

In further reply to Mr. CLODE, witness stated that Sutton had not given the statutory notice required by section 52 of the Public Health Act for the acquisition of part of the Company's undertaking. Under the provisions of that Act the Company were able to give Sutton a good and sufficient supply of water.

Mr. *G. H. Hill* (Engineer-in-Chief of the Company) said great difficulties would arise if Sutton were taken away.

In cross-examination witness said he would not give any guarantee that the Company would not apply to Parliament in future for powers to sink wells in Sutton Coldfield. If a further supply of water were absolutely necessary, and the Company had nowhere else to go, they would turn to Sutton. It was one of the few places from which they could tap a new supply.

This concluded the case for the promoters.

Mr. RAM asked, on behalf of the opposition from Sutton Coldfield, that their lordships should allow the inhabitants of the district to come

out of the Company's area altogether and supply themselves. If the Committee could not see their way to grant this, he asked that a clause should be inserted in the Bill giving a guarantee that the Company would not sink wells within 2½ miles of Sutton Coldfield.

Counsel did not call evidence; and the Committee, after a short deliberation in private, decided that the preamble of the Bill had been proved.

LEGAL INTELLIGENCE.

THE ALLEGED BREACH OF A COAL CONTRACT.

Last Wednesday, Mr. Justice SCRUTTON delivered his reserved judgment in the action of *Michael Pintus and Sommerfeld, Limited, v. H. S. Higginbottom, Limited*, a report of which has already been given in our pages. [See *ante*, p. 189.]

His LORDSHIP said the plaintiffs sued defendants for damages for breach of a contract to supply coal—alleging that they had contracted to supply the Turkish Government with coal yielding the quantity of coke and gas of the candle power contained in an analysis of Arley gas coal received from the defendants on May 20, 1911 (the whole large order depending on the first sample cargo being satisfactory), and that to carry out this contract the defendants undertook to supply them with Arley gas coal, or other coal equal to the analysis. They further alleged that, under the contract, the defendants shipped a cargo of coal which was not in accordance with the analysis, was not merchantable, and was rejected by the Government, whereby demurrage was occasioned to the vessel which had brought it. Ultimately the plaintiffs, after incurring considerable expense, were forced to make a large allowance to the Government; and they claimed some thousands of pounds as damages, in addition to a small sum for dock dues at Liverpool. The defendants replied that they did not sell on any analysis; that they did sell a quantity of Lostock-Arley or Norley gas coal, one-half screened, one-half "smalls;" that the cargo forwarded complied with this description; that they had nothing to do with the Turkish Government contract; and that, in any event, most of the damages claimed were too remote. The trial had occupied six days, and a large mass of documentary and oral evidence was given of a very contradictory and complicated nature. It appeared that the defendants were interested in two collieries at Lostock Lane and Norley, near Wigan; and the Arley seam was a well-known seam of coal which ran through the Lostock Lane, among other, collieries. In the Norley Colliery there were two seams, called the Wigan 4-foot and the Wigan 5-foot, not part of the Arley seam. From April to July, 1911, the defendants had an average weekly output of 335 tons from the Lostock-Arley seam, or 1340 tons a month; 1800 tons from the Wigan 5-foot seam, or 7200 tons a month; and 50 tons from the Wigan 4-foot seam, or 200 tons a month. They heard that the plaintiffs wanted gas coal, and offered them Lostock-Arley at 11s. 3d. per ton f.o.b. Garston; sending an analysis dated March, 1911. This was an analysis of Arley gas cobbles—a selected coal of a certain size. The plaintiffs replied that the Arley coal was too dear, and that they wanted an unscreened gas coal 50 to 60 per cent. of small, at about 8s. 6d. Small coal, or slack, had in Lancashire a meaning varying with the screens used at the particular colliery for picking out large coal, and meant the coal and dirt which went through the last screen with the smallest mesh. In unscreened Lancashire coal, there would be about 35 per cent. of small. An unscreened gas coal with 50 to 60 per cent. of small would be a very poor coal, as the drop in price from 11s. 3d. to 8s. 6d. showed. The trouble had arisen from the plaintiffs' attempt to apply to the cheap coal, half smalls, which they wanted to buy, the analysis of a large and expensive coal sent to them in May by defendants. How much the analysis would be affected by the addition of an equal quantity of smalls was a matter of uncertainty, depending upon the particular seam and the way in which it was then being worked. In Durham, the seam being cleaner, the smalls were chiefly broken coal, and differed less from the large; but in Lancashire the seams were dirty, and the dirt went in the smalls. The ash or dirt would consequently be doubled or trebled; and as gas could not be made out of ash, the production would be diminished by at least from 7 to 10 per cent. It was unusual in Lancashire to buy or sell coal with a warranty of analysis, though it might be produced as a guide. The defendants accordingly quoted 8s. 6d. per ton for a sample cargo of half Lostock Lane screened Arley gas coal and half Arley gas smalls. Such a cargo would be inferior to a cargo of unscreened Arley coal, which would not contain 50 per cent. of smalls. Thereupon plaintiffs asked defendants to quote for 30,000 tons, spread over six months. As the defendants' entire output of Arley for six months was only 8000 tons, this was obviously impracticable; and they asked that the period should be twelve months, and that they should be at liberty to supply half Lostock-Arley and half Norley. The Norley 5-foot seam was about equal to the Lostock-Arley seam. On June 27, plaintiffs tendered to the Turkish Government for gas coal, according to an analysis for Arley cobbles received from defendants in May, at 14s. 10½d. per ton, which, after paying freight, only left a profit of about 1s. a ton. An order was sent for a sample cargo which was to comply with the analysis; and if it did, a further order for 15,000 to 20,000 tons would have resulted. Thereupon the plaintiffs approached the defendants again, and the latter knew that their Arley analysis had been sent to Constantinople, but did not know the terms of the contract with the Government, or that any analysis had been guaranteed. They offered to supply from 30,000 to 40,000 tons of Lostock-Arley or Norley 4-foot coal, of which they enclosed an analysis. He found that the contract was as stated by the defendants—viz., to supply, subject to a sample cargo being satisfactory, Lostock-Arley or Norley gas coal, or equal coal, one-half screened one-half smalls. There was nothing to show that the defendants contracted to supply a cargo, half of which was small coal, according to an analysis of large coal only, or, in other words, to supply for 8s. 6d. a coal which would comply with the analysis of a coal at 11s. 3d. It might be asked how the plaintiffs could be so foolish as to contract with the Government on analysis without binding their suppliers in the same way; and he was afraid the answer was that the Government contract had been obtained, to the knowledge of the plaintiffs, by bribery, and that they relied upon similar means to get their deliveries through. The vessel with the sample cargo arrived at Constantinople in August, and the representative of the Government Gas-Works was at once struck with the unnatural amount of smalls. He tried 400 tons, and, of course, found that the coal did not comply with the guaranteed analysis; and he rejected the cargo. After some negotiations, a compromise was effected with the Government—the plaintiffs making an allowance of 35 per cent.; and they put forward their claim on defendants for damages. Having found that the plaintiffs' version of the contract was inaccurate, and that it was not, as they alleged, an express term or condition that the cargo would be in accordance with, or approximately equal to, the analysis of March, 1911, there still remained the question whether the cargo was in accordance with the defendants' contract, and merchantable as "gas coal." This phrase was a vague one, as all coal would make gas; but it appeared commercially to describe a coal of which gas produced per ton per hour multiplied by the illuminating power of the gas tested in a No. 2 burner reached a certain not very well-defined figure; while the coke from it was of a fair quality, and could be used to heat the retorts in which the gas had been produced, leaving a margin for sale. The range of gas coals had increased of late years, as incandescent burners had enabled gas of less illuminating power to be used; the parliamentary standard having been lowered. Two tons of coal were brought back from Constantinople, and experts on each side had given their opinion of it; and, after careful consideration, he had arrived at the following conclusions: That the cargo consisted of (1) Lostock coal, 883 tons; Lostock slack, 91 tons. This was Arley gas coal, and clearly in accordance with the contract. (2) Norley 4-foot Wigan coal, 76 tons. This was Norley gas coal, and in accordance with the contract. (3) Norley 5-foot Wigan coal, 1906 tons; Norley slack, 295 tons. This was a Norley coal, and the questions with regard to it were whether it was a gas coal, and whether, in view of the analysis sent of Norley Wigan 4-foot coal, it was open to supply Wigan 5-foot under the contract. He found that the last-named coal was at the time of the contract a gas coal, though a low second-grade one. It would not have been one before 1906, but had become one with the lowering of the illuminating power standard. Some 50,000 tons had been supplied by the defendants for gas-making before the date of the contract, and 25,000 tons were supplied to the Salford Gas Department afterwards. As to whether the coal could be supplied under this contract, it came within the words "our Norley gas coal" and "other equal coal," as it was equal to Arley. The Norley coal was therefore within the contract. This accounted for more than three-quarters of the contract quantity; and there remained some minor shipments of smalls. (4) New Haden rough slack, 407 tons. This was not a gas coal, nor was it equal to Arley or Norley. (5) Central silkstone rough slack, 260 tons. This was a gas coal of a lower grade, but equal to Arley or Norley. (6) South Kirby and Featherstone washed slack, 71 tons. This, though there was some good gas coal at this colliery, was not gas coal, or equal to Arley or Norley. (7) Abram fine slack, 213 tons. Though Abram slack from the Arley seam was good gas coal, and equal to, or better than, Lostock-Arley, he found that this Abram slack was from the Orrell seam, and was not gas coal. Roughly, 700 tons, or one-sixth of the cargo, was not in accordance with the contract; and he was of opinion, therefore, that the defendants had broken their contract. What was the measure of damages? He thought the proper measure was the difference in mercantile value at Constantinople, at the time of the ship's arrival, of the cargo delivered as compared with the cargo which should have been delivered. In considering this question, as the plaintiffs had taken the cargo, the defendants might have credit for the superiority of part of it as against the inferiority of other parts. If the parties desired it, he would hear further evidence on this point; but his present impression, on the evidence already given, was that the superiority outweighed the inferiority, and that the damages were therefore nominal. As to the small sum claimed in respect of dock dues, he found that the claim failed.

Mr. LESLIE SCOTT, K.C., for defendants, said he did not desire to call further evidence.

Mr. LECK, K.C., asked for a short time to consider the point; and his Lordship granted it.

Damages for Personal Injury.

In the King's Bench Division of the High Court of Justice last Wednesday, the action of *Barker v. South Metropolitan Gas Company* was tried before Mr. Justice Rowlatt and a Common Jury. The plaintiff, Alfred Charles Barker, who is the licensee of the "Selborne Arms," Camberwell, claimed damages for personal injury caused through the alleged negligence of defendants' servants in leaving about his premises a ladder, over which he stumbled and fell, and injured his shoulder. Defendants admitted that they left the ladder in plaintiff's yard, permission to do so having been given to their servant; and they denied that they were guilty of negligence. Mr. Lewis Thomas, K.C., and Mr. R. W. Turner appeared for the plaintiff; Mr. J. B. Matthews represented the defendants. His Lordship, in leaving the case to the Jury, asked them two questions: (1) Did the plaintiff know, or ought he to have known, the position of the ladder before the accident? (2) Was it the duty of the potman either to have removed the ladder or to have reported its presence to his master? The Jury, after considerable deliberation, answered both questions in the negative, and assessed the damages at £10. His Lordship entered judgment for the plaintiff for this amount, with costs on the County Court scale.

The Directors of the Oriental Gas Company, Limited, have resolved to pay an interim dividend of 3½ per cent., free of income-tax, on account of the year ending the 30th of June next. The dividend is at the same rate as last year.

MISCELLANEOUS NEWS.

EXAMINATION IN "GAS ENGINEERING."

The City and Guilds of London Question Paper.

The following were the questions put to candidates last week in the first of the examinations in subjects connected with the gas industry which are held annually under the auspices of the City and Guilds of London Institute. The questions were in "Gas Engineering," and the Examiner was Mr. Thomas Glover, of Norwich. Candidates were directed to confine themselves to one grade only, and not to attempt to answer more than eight questions in the four hours allowed. The maximum number of marks obtainable is appended to each question.

GRADE I.

1. Compare the relative advantages of "moulded" and "built" retorts, and give particulars of a method of constructing the latter form of retort. [35.]

2. Show, by a front elevation sketch, the arrangement of branches on the mouthpieces with sweep and ascension pipes for a setting of eight retorts in three tiers. State what precautions it is necessary to observe to ensure smooth working. [35.]

3. State in degrees Fahrenheit the working temperature of a fire-clay retort, taken when the spent charge is withdrawn. What would be the effect on the production of gas, and on the other products, of varying the temperature 500° either way? [40.]

4. Sketch any form of condenser with which you are familiar, and state how you calculate the superficial area for cooling a given volume of gas. [35.]

5. What parts of an exhauster require lubrication, and what quality of oil would you use? [35.]

6. Draw a large scale detail of the upper part of a purifier side-plate, showing the construction of the lute and the flanges for jointing the side-plates. Give all measurements, including thickness of metal and pitch of bolt-holes. [45.]

7. Two-and-a-half million feet of gas were registered at a temperature of 44° Fahr. with the barometer at 29·2 inches. Correct the volume to normal temperature and pressure. [40.]

8. Give the *minus* and *plus* pressures at each stage from the hydraulic main to the holder, showing what pressure each separate portion of the plant requires. [40.]

9. How is purified gas tested for ammonia, and what results would be regarded as satisfactory? [30.]

10. Give a brief description of the apparatus, and course of the gas, from the outlet of the purifiers to the consumer's burner, and indicate what precautions are taken to ensure a constant and satisfactory supply. [35.]

FINAL EXAMINATION.

1. Sketch the charging portion of a De Brouwer machine, and give the speed of the charging belt in feet per minute from the following data:—

Speed of motor.	1600 revs. per minute.
Pulley on motor	9 inches diameter.
Driven pulley on projector . .	11 inches diameter.
Projector belt drum	8½ inches diameter. [40.]

2. Give a description of the Mond system of producer-gas manufacture. What advantages and disadvantages would you expect from the application of this system to the heating of retort-settings? [40.]

3. Show by sectional drawings the progress of carbonization in "intermittent" and in "continuous" vertical retorts. Discuss the question as to the path of the gas from the coal undergoing carbonization to the outlet-pipe of the retort. [40.]

4. A purifier constructed for the purification of the gas as it passes through the bed of material in an upward direction has to be converted so as to allow of downward purification. How would you proceed to carry out the alteration, and what beneficial results might be expected to follow the alteration? [45.]

5. Assuming that coal costs 12s. per ton delivered into store at a gas-works, and that 75 per cent. of the cost was recovered by the sale of bye-products, what would be the approximate cost per 1000 cubic feet of gas into the holder? Show details of how the cost is made up. [40.]

6. What distillates of coal tar can be advantageously used for washing crude coal gas? What results would you expect from such treatment with various grades of distillates, and how does gas-works practice differ, in this respect, from that followed in coke-works? [40.]

7. How is cyanide formed during the distillation of coal, and how can it be extracted from the gas and rendered marketable? [35.]

8. Compare the cost per brake horse power of power derived from an electric motor and from a gas-engine. At what prices per unit and per 1000 cubic feet would the two sources of power be equal for constant loads? [30.]

9. In the event of several settings of retorts becoming unsealed, and the foul mains being under a vacuum of a few tenths of an inch, how might this occurrence be detected and remedied, and what might be done to avoid unpleasant results at the consumers' burners? [30.]

10. Assuming that a gas coal contains nitrogen equivalent to 100 lbs. of sulphate of ammonia, give a balance-sheet showing the distribution of the nitrogen in the products of distillation and in the coke. [35.]

Kilrush Water Supply.—The Local Government Board for Ireland have intimated to the Kilrush (co. Clare) Urban District Council that, if they fail to comply with a recent order to provide a proper water supply for the district, recourse will be had to legal proceedings to compel them, as the sanitary authority, to perform what is considered a bounden duty. The Chairman (Mr. L. O'Brien), at the last meeting of the Council, said the Local Government Board could do as they pleased, but the Council would not be influenced by threats. The letter was marked "No order."

IMPERIAL CONTINENTAL GAS ASSOCIATION.

Half-Yearly Report.

At the Half-Yearly General Meeting of the Association on the 6th prox. the Directors will present the following report, which is accompanied by the accounts, on the results of the Association's operations in the six months ended the 31st of December.

The profit of the half year was £236,259 18s. 6d., which, together with the sum of £44,608 3s. 9d. brought forward from the previous half-year's account, makes a total of £280,868 2s. 3d. available for appropriation, as compared with a profit of £275,453 18s. 11d. and an available total of £321,199 11s. 8d. on Dec. 31, 1911. The reduction in the profit for the past half year is due to the loss of the Vienna and Aix-la-Chapelle stations, which were acquired by the Municipalities of those towns in December, 1911, and June, 1912, respectively. The Directors recommended a dividend for the half year ended December 31, 1912, of 4½ per cent., less income-tax.

The total output of gas in the towns supplied by the Association showed an increase at the rate of 6·37 per cent., or about 350 million cubic feet; and the number of consumers was greater by 8 08 per cent.

The total number of meters in use at the close of the half year was 539,378, of which 165,211, or 30 62 per cent., were prepayment meters. At the end of December, 1911, the total number of meters (including 46,803 at Vienna and 30,879 at Aix-la-Chapelle), was 574,001, of which 152,661, or 26·6 per cent., were prepayment meters.

In the course of the half year under review, 96 miles of new mains were laid; making a total length on Dec. 31, 1912, of 2250 miles.

The plant and mains at all the stations were maintained in their usual efficient condition.

The quantity of coal carbonized in the half year was 486,112 tons, of which the average gross cost delivered upon the works was 17s. 3·86d. per ton, or about 5d. per ton more than in the corresponding half year.

The oil used for water gas amounted to 3074 tons. In the corresponding half year, the quantity so employed was 3520 tons. This quantity was considerably less than that employed in the corresponding half year, for the reason that, owing to the abnormal rise in the price of oil from 43s. 7·5d. per ton in the latter part of 1911 to 63s. 4·7d. in the half year under review, it was found more economical to use coal, the price of which had increased, as indicated above, only to a small extent. The value of coke was higher; and tar and ammonia products continued to improve in price.

At the Antwerp station, exclusive contracts were concluded for the supply of gas until the year 1947 to the suburban communes of Austruweel, Borsbeek, Lillo, Oorderen, Schelle, Wilmarsdonck, and Wommelghem; and until 1945 with the commune of 's-Gravenwezel. All these communes will be supplied from the existing works.

The six new benches of five-metre vertical retorts at Berchem, referred to in the last report, were completed and put in action with satisfactory results; and good progress was made with the construction of two sets of water-gas plant at Hoboken.

At Berlin, the existing contracts with the suburban communes of Gross Ziethen, Grunewald, Marienfelde, Nikolassee, and Tempelhof were prolonged for periods varying from eight to twenty-five years.

The additional settings of vertical retorts at Mariendorf and Weissensee, mentioned in the last report, were completed and put in action.

At Brussels, the Association acquired by purchase the concession and gas-works at Anderlecht, a suburb situated on the west side of Brussels and adjoining the communes of Forest and Molenbeek, already supplied by the Association. A concession for the supply of electricity in Anderlecht was also obtained from the communal authorities. Exclusive contracts were secured for the supply of gas and electricity in the suburbs of Sterrebeek and Wesembeek until 1948.

Exclusive contracts for the supply of gas until 1962 were concluded with the communes of Domburg, Oostkapelle, Serooskerke, St. Laurens, and Veere, situated in the Island of Walcheren. These places will be supplied from the gas-works at Flushing, where a new purifier-house with three purifiers was brought into use in the course of the half year under review.

At Hanover, exclusive contracts for the supply of gas were concluded with the suburban communes of Anderten, Brink, Harenberg, and Godshorn until 1950.

The new gas-works at Linden, referred to in the last report, were completed and successfully put in action.

The Directors who go out of office by rotation are Robert Tindall, Esq., Sir Charles James Jessel, Bart., and John Henry Birchenough, Esq., C.M.G. These gentlemen are eligible for re-election, and offer themseves accordingly.

The Directors regret to report the death of Mr. J. Gurney Fox, the Senior Auditor, which occurred in December last.

Profit-Sharing for Workers.—Under this title, Mr. James F. Hope, who, in conjunction with other Members of Parliament, has reintroduced his Co-Partnership Bill, the scope of which was indicated in the "JOURNAL" a fortnight ago (p. 109), showed, in an article in the "Weekly Dispatch" for the 13th inst., how it would cure labour unrest. In introducing his subject he said: "I believe that the remedy is to be found in community of interest between employer and employed; and that it is only on the principle of co-partnership that a lasting solution can be reached. Under the present industrial system, the workman is paid a fixed wage, irrespective of whether or not the employer is making huge profits out of the business. By the provisions of the Co-Partnership Bill, once the capital of the company has a fair return, any surplus above that is divided among the company and the co-partners. Instead of the workman working only for himself, as he naturally does when he is paid a fixed wage, by this scheme it is to his interest to make the employer's business a success, for it is his business too—any extra profit to the employer automatically bringing extra wages to him."

MANCHESTER GAS PROFITS.

A Record Year.

At a Special Meeting of the Gas Committee of the Manchester Corporation last Tuesday, the Chairman (Mr. W. Kay) made the announcement that, despite all adverse circumstances, the profits for the past financial year were a record—exceeding £260,000. The nearest approach to this was in 1903, when the profits reached £224,000. On that occasion, the price of gas was 2s. 9d. per 1000 cubic feet, compared with 2s. 3d. last year. The Committee decided to allocate £50,000 to the relief of the rates; but next year the sum will be £52,097—equal to 1¾ per cent. on the capital expenditure. The increased consumption of gas was equal to 4·48 per cent. The Committee, in dealing with the disposal of the £260,000 of profits, placed a substantial amount to the reserve fund, and provided for renewals, increased cost of materials, and the requirements necessitated by the proposal to reduce the price of gas. The total number of consumers was reported to be 185,295, compared with 183,793—an increase of 1502. The number of cookers in use was 65,371, against 58,799, or 6932 more - due, in a large degree, to the coal strike. The number of gas-fires, &c , was 6731, against 2319—an advance of 4412. The grillers in use totalled 33,261, compared with 31,653, or 1608 more. Mr. Kay expressed his pleasure at announcing the large profits, and said the Committee had had a record year all round, despite the increased cost of materials. Considering the price of gas was lower by 6d. than it was in 1903, the increased profits in the past year were all the more remarkable.

OPPOSITION TO IRISH ELECTRIC LIGHT ORDERS.

In the last number of the "JOURNAL" we noticed briefly proceedings in opposition to applications for Provisional Orders for electric lighting by the Urban District Councils of Banbridge and Portrush. In addition, there has been an inquiry into a similar application by the Dromore Council.

Banbridge.

Our report with regard to this place ended with the statement that Mr. T. E. Pye, F.C.S., of Chichester, gave evidence. We are now able to give an indication of its nature.

Mr. *Pye*, examined by Mr. HANNA, K.C., who appeared for the opponents, stated that he had without notice examined the gas-works. He found they were well equipped with modern plant, and were more than capable of giving to Banbridge a thoroughly efficient and full supply of gas. He had also, unknown to the Company, carefully inspected the shop lighting in the town. In the low parts, inverted burners were giving excellent results; thus proving that the pressure in the mains was fully adequate, and much above ordinary statutory requirements. The gas was of good quality. The street-lamps belonging to the Council were mostly in such bad condition that incandescent lighting could not be adopted, but for a comparatively small outlay excellent incandescent lighting of the streets by gas could be installed. Witness proceeded to criticize the proposed scheme, on the basis of statistics, compiled from various sources, of all the electricity undertakings throughout the United Kingdom belonging to the ratepayers of towns containing 13,000 population and less. He produced a number of diagrams, which graphically represented the remarkable discrepancies between the promoters' estimates under the scheme and the actual average experiences of the existing undertakings referred to, as reported in official returns.* The capital outlay as regards the twenty existing concerns was shown by these diagrams to be £3 7s. per head of the population; the Banbridge scheme providing for only 12s. 9½d. per head. The promoters' scheme (prepared by Mr. Pleasance) estimated for an ultimate surplus of 6s. 8d. from every £1 of gross revenue; whereas witness's chart of actual experiences showed the average result of the working of the twenty concerns scheduled to be a deficit of 1½d. per £1 of gross revenue. The financial results per head of the population were also shown diagrammatically to average at 8d. deficit, in comparison with Mr. Pleasance's estimate of a surplus of 10½d. per head. Witness next dealt with Mr. Pleasance's published statement that "Electricity at 6d. per Board of Trade unit compares favourably with gas at 2s. per 1000 cubic feet." The highest efficiency obtainable in practice from the best type of electric filament lamps being stated by electricians at the equivalent of 800 candles for one hour per unit, this amount of lighting by electricity would cost in Banbridge 6d. Assuming the low efficiency of 16 candles per foot from an incandescent gas-burner, 50 cubic feet of gas would yield the same equivalent of 800 candles for one hour, and would cost in Banbridge 2¾d., as compared with 6d. for electricity. Witness proved these figures by diagrams, prepared from actual metered tests from the Chichester showroom windows, of gas and electric lighting costs respectively—tests which showed indisputably that in Chichester, with gas at 3s. 6d., and electricity at 6d., the cost of the latter was just over three times that of gas lighting. Witness examined Mr. Pleasance's claims for the superior hygienic value of electric lighting, and dealt with them by extracts from reports of investigations by Dr. Toogood, Dr. Samuel Rideal, Professor Lewes, and others; including a statement by Dr. Dudfield as to the reason for, and the satisfactory result of, the change from electric to gas lighting at the Institution Rooms of the Society of Medical Officers of Health. Similarly, the claims as to superior safety were met by fire statistics showing that fires caused by electricity per consumer are about 4 to 1 compared with those caused by gas.

In cross-examination by Mr. D. WILSON, K.C., witness said he had never heard of anyone being asphyxiated by electricity, but there were various fatalities due to accidental electrocution, and many cases of injury due to electric shock. The average age of the twenty undertakings he had reported upon was nine to ten years. The cost of installations might have been reduced of late; but the Chichester undertaking had not been open four years, and the capital outlay there (share and loan) was £3 10s. per head of the population. Nothing was provided for land for the works; and even if the land belonged to the Council, an estimate of capital expenditure which did not provide for the value of the land on which the plant was to be erected certainly was not a fair one. To this extent, and in other particulars, the estimate of capital required for Banbridge was manifestly deficient.

Mr. *G. A. Mearns*, the manager of the gas-works, said he considered the supply of gas in Banbridge reasonably efficient. They had 18 retorts capable of supplying 7000 cubic feet per mouthpiece in 24 hours. They had two gasholders with a capacity of 50,000 cubic feet. He had never had any complaints as to the insufficiency of the pressure of the gas, or as to its quality. With reference to the public lighting, he thought that, with a comparatively small expenditure, there was nothing to render necessary the introduction of electricity. It was pointed out to witness that it had been stated that the Gas Company would be prepared to light the town on the incandescent system for £180 per annum, as compared with their present price of £228; and he was asked if they would still make a profit if they did so. His reply was that they would be using less gas.

Mr. *Jacques Abady* was called on behalf of certain opposing ratepayers. He said that, judging from the particulars of the scheme which had been put before him, he was strongly of opinion that it would result in financial loss to the ratepayers, and lead to an increase in the rates. Comparisons which had been made with reference to the gas in Banbridge were absolutely incorrect. He considered that the light supplied by the Gas Company was adequate. The pressure was ample, and the quality of the gas exceedingly good—considerably better than it was in many large places, even London. As regarded the public lighting, however, he did not think it efficient, owing to the distance apart of the lamps and the flat-flame burners used. He would almost call this class of burner antediluvian. He had not seen flat-flame burners for years before he came to Banbridge. The result of these being employed was that 5 or 6 cubic feet of gas were used every hour, and gave a very small light; whereas if incandescent burners were used, only one-third or one-fourth of the gas would be required, and there would be a much better light. With proper lanterns fitted with incandescent burners, he thought they could have more than double the light they had at present, and at less expense. Witness went through the estimate of the cost of the electric lighting scheme, and subjected it to exhaustive criticism. He said he considered almost all the items inadequate. His estimate was £4997, as compared with the £3200 of the Council's expert (Mr. Pleasance). Summing up his calculations, he fixed the capital required at £6086. Assuming his estimate to be correct, he contended that the promoters could not make ends meet. Reckoning the interest on a loan of £5000 to be 3½ per cent., and the repayment of the loan at 4 per cent., which would be £157 and £200 per annum respectively, adding this to the annual expenditure on the scheme, and deducting from it the annual revenue of £693 which he had fixed, he thought there would be a loss of £370 a year. Even with this he was making an assumption in favour of the scheme which he was not entitled to make, because he did not think the cheeriest optimist would think he was going to get the full revenue for the first year or two. Consequently, the loss on the first year's working would be about twice his figure, or even more. Witness criticized Mr. Pleasance's remarks in his estimate as to the efficiency of the electric light, and said they were misleading, because what he did was to take the most efficient electric lamp and compare it with the most inefficient gas-light. The gas at Banbridge was capable of giving a light of 25-candle power with incandescent burners. Taking this, with the price of the gas at 4s. 7d. and electricity at 6d. per unit, he wanted to show the comparative cost. With the carbon filament electric lamp, the cost would be 18s. for the current of 36 units for a certain number of hours; the "Tantalum" lamp would take 14 units, and cost 7s.; the metallic filament lamp would take 11·2 units, and cost 5s. 7·2d. As regarded gas, with the incandescent burner they would require 3200 cubic feet for the same number of hours; and it would cost 2s. 3½d. This was the relative cost of the two lights, both of the same approximate efficiency, and burning the same number of hours. "These are the true facts," added witness, "and I fail to see anything, unless put in a misleading way, which justifies the statement that electricity at 6d. per unit will compete favourably with gas at 2s. per 1000 cubic feet." With regard to the fittings, the people will have to expend, on an average, £5 each to fit up their houses for the reception of the new light.

Witness was subjected to cross-examination by Counsel for the promoters (Mr. John Gordon, K.C.); but he insisted that there would be a loss on the electric light undertaking if carried out, and said he based his statement on long experience of electricity undertakings in England with which he was acquainted.

Other evidence was given, and the inquiry was adjourned.

Dromore.

As in the preceding case, the inquiry at Dromore was conducted by Mr. G. B. DEANE.

Mr. JOHN GORDON, K.C., and Mr. CHARLES MURPHY appeared in support of the application, which was opposed by a number of ratepayers, represented by Mr. R. BEST, K C., and the Dromore Gas Company, Limited, on whose behalf Mr. R. J. HUNTER watched the proceedings.

Mr. GORDON, in opening the case, said the Urban District Council were anxious to provide electricity for lighting and power purposes. The population of Dromore was 2364 in 1911, and 2367 in 1901. The gross valuation of the town was £5480. The rates up to 1909 were 5s. in the pound; and they had increased last year to 5s. 6d., because some further officials had been created as a result of recent legislation. The Council's borrowing powers were £10,200, and their existing debts £1759. The town was now lighted by gas; but the present Company, which had been in existence since 1860, had no statutory powers, and, so far as could be ascertained, no annual returns were published by

* The diagrams referred to by the witness, copies of which we have seen, are very well produced, and will, we think, materially assist the Board of Trade officials in appreciating the divergence between the estimates prepared for the electricity scheme for Banbridge and the actual experience of all undertakings comparable with that town.—ED. J.G.L.

them. The Council alleged that the Company were a source of annoyance to them, as the public could not get over the streets and roads owing to these being repeatedly opened for the purpose of repairing mains and service-pipes. Gas cost the consumers 5s. 3d. per 1000 cubic feet. There were nine members of the Council, and, with one exception, they were in favour of the proposed scheme. The Council had been advised by an eminent expert (Mr. Pegg), who would be examined. The opposition included a number of ratepayers, who now showed a great desire for drainage and artizans' dwellings; but if the Council had adopted such schemes, they would have been opposed. Mr. Pegg submitted a scheme costing £3988, and an alternative one at a cost of £3400; and it was the latter which the Council desired to carry out.

Mr. *A. F. Wright*, the Clerk to the Council, gave particulars of the town valuations, loans, rates and borrowing powers, and contracts with the Gas Company for the town lighting. He said the Company daily opened the streets, but latterly the Council insisted on having notice. He did not think the gas was good in quality and sufficient in pressure. He had never seen new mains put down within the last thirteen years. Electric lighting was suggested informally in 1910. The matter was noticed in the Press; and Mr. Pegg wrote to witness thereon. Eventually he was deputed to report and submit an estimate of the cost of a scheme.

Mr. *Pegg* was then called, and, after explaining the scheme, was cross-examined by the Counsel representing the Gas Company and the ratepayers; and the inquiry was adjourned.

BRIGHTON TOWN COUNCIL AND THE GAS COMPANY.

The Company's Accounts—Suggested Purchase of the Undertaking.

At the Meeting of the Brighton Town Council last Thursday, the minutes presented by the Lighting Committee contained a report from the Borough Accountant on the accounts of the Brighton and Hove Gas Company. In the course of it he said: "Of the total capital authorized, there remains £131,563 unissued, none having been called up for several years past. At the end of last year, the capital account was overdrawn to the extent of £5873. The only capital outlay incurred was £7784 for fittings and stoves on hire (after allowing for depreciation written off). It is now some considerable time since any charge has been made against capital in respect of new mains; the cost of all extensions of mains, including those laid for the service of new properties, having been charged to revenue account. I am informed that the additions made of late years have been few and unimportant. While accepting this, I cannot, however, admit that the reasons advanced for the procedure that has been adopted in this particular adequately justify the course that has been taken."

Alderman GERVIS having moved the adoption of the Committee's proceedings,

Mr. BLACK said he had no feeling of hostility towards the Gas Company, but he had several times had to call attention to the accounts. The Company had a habit of charging to revenue account an item which ought to be placed to capital account; and the effect of this was that the revenue portion was reduced, and therefore the reduction in the price of gas to the citizens was hindered, or was not accelerated as it ought to be, and, the items not being charged to capital account, this account was not increased as it should be. Both of these would, in the case of any future purchase, militate against the best interests of the Corporation. He hoped this protest would elicit from the Chairman of the Committee an assurance that the report of the Accountant would have further consideration, and that the Company's attention would be directed to it.

Mr. TINDALL hoped the Committee were going to get a report from the Accountant as to what sums had been dealt with in the manner referred to.

Alderman CARDEN said he should like to recommend to the Committee's consideration the advisability of purchasing the Company's business. Their capital was just over £700,000, and their earnings were £267,000. Of course, their working expenses were very much higher than those of the Corporation electric lighting undertaking; but the Company made £69,000 net profit on a revenue of £267,000. He did seriously think that the time had arrived when the Corporation should take steps to acquire the undertaking. The two businesses could be worked together very much more economically than they were now.

Mr. GRIFFITH observed that it would be exceedingly interesting, if the Corporation purchased the Company's business, to see how quickly the profits disappeared. [Laughter, and "Hear, hear."]

Alderman GERVIS said he was quite in sympathy with Councillors Black and Tindall as to the action of the Company; and if the latter would bring the matter forward at the next meeting of the Lighting Committee, he was sure it would be carefully considered, though, human nature being what it was, he had not much hope of reformation. He hoped Alderman Carden would not agitate for the acquisition of any fresh undertakings until the electric light undertaking had an adequate reserve fund.

The proceedings were confirmed.

The Fatal Explosion at Hebburn-on-Tyne.—After hearing some evidence at the resumed inquest last Thursday on the bodies of Annie Gray and George Collinson, who were killed by an explosion in a house at Hebburn-on-Tyne on March 30 [as recorded on p. 53 of the "JOURNAL" for the 1st inst.], the inquiry was adjourned till next Thursday, so as to enable an expert examination to be made of the electric cable and gas-mains. Several witnesses spoke to a smell of burning gutta-percha; and Inspector Riddell expressed the opinion that the explosion was caused by a fused cable. When the electric cable was opened up, he detected a smell similar to that which he found in the house after the explosion. Gas was not used for lighting purposes in the damaged houses.

AIR AND SMOKE IN THEIR RELATION TO HEALTH.

Lecture by Professor Lewes.

In the last number of the "JOURNAL" (p. 202), reference was made to an amusing incident arising out of a discussion following a lecture given by Professor Vivian B. Lewes, F.I.C., F.C.S., at the close of the Health Week at Doncaster. The Professor is always interesting and we therefore give some extracts from his lecture.

Among the many marvels that Science reveals to us, there is nothing more wonderful and entrancing than the beautiful actions going on around us in the atmosphere; and when we study these, we find that air is the medium Nature has chosen for creating all forms of animal and vegetable living matter, for helping on its healthful life, and, when life has run its span, reconstructing from the waste *débris* new forms of living matter. Slowly over long ages our knowledge of these actions has been built up; and now the main outlines of the cycles in which the energy of the sun and the chemical actions among the gaseous compounds found in the atmosphere keep all matter in circulation are beginning to be understood, though the mystery of life itself is still unsolved. We have learned enough, however, to know that clear, pure air is the greatest factor in the well-being of both animal and vegetable life, and that Nature has so arranged that the air is kept pure and fit for her work, if only we did not continually put barriers in her path.

Long before the Christian era, the presence of the atmosphere was felt, and that it had weight was suspected by Aristotle. But it was not until the Seventeenth Century that the labours of Galileo, Torricelli, and Pascal proved that it was so, and that 12⅓ cubic feet of air weigh about 1 lb. Near the close of the Eighteenth Century, Priestley and Lavoisier showed that several different gases went to form air, and that it contained as its chief constituents oxygen—a gas all-powerful in urging on life and combustion, the activity of which was diluted down to the necessary limit by another gas, nitrogen, characterized by its great chemical inertia. Besides these main constituents, there were always found small quantities of the vapour of water, another gas called carbon dioxide, and also traces of ammonia. These three are now known to play nearly as important a part as the main constituents, and they are often spoken of as being the "minor" constituents of the atmosphere.

During life, the human being assimilates nourishment from food and drink, and from these builds up the tissues of the body; and these in turn serve as the fuel in the body which, by undergoing a process of slow combustion with oxygen, taken into the lungs during respiration, and distributed by the circulation of the blood, creates the warmth and the energy of body and brain which we call "life." The combustion of the tissues forms from them carbon dioxide and water vapour, which are respired from the lungs and skin, and mingle with the atmosphere. In the course of a day, 3½ million tons of oxygen are withdrawn from the air by such actions as respiration and other forms of combustion, fermentation, and decay, and are replaced by the products of these actions—water vapour and carbon dioxide. These waste products of animal life and vegetable decay form the food of plants, which, absorbing them under the influence of the sun's rays, set up a series of beautiful chemical reactions which result in the carbon of the carbon dioxide and water vapour forming the solid tissues of the plant, while oxygen is returned to the atmosphere to help to keep its composition constant.

These reciprocal cycles would be impossible were it not that gases, unlike solids and liquids, do not arrange themselves in layers according to weight, but intermingle in spite of gravity, so that the products of the populous city are spread throughout the whole atmosphere, and are thus brought to the growing plants that need them. It is this process of so-called "diffusion" also which enables the whole vast bulk of the atmosphere to come into play in diluting the products, and keeps the composition of the atmosphere so constant that we can hardly tell by analysis the difference between town and country air.

Sun is essential to all life. It is the original source of all energy, and is an absolute necessity for plant life. Vegetation gives us part of our food, and fattens the flocks that supply the remainder; and with the assimilation of this food the energy latent in the plant is transferred to our tissues. Cut off the sun, and the plant ceases to take in carbon dioxide from the air, and ceases to grow; and this in turn cuts off our energy supplies, food becomes dear, and life rapidly gets sickly and unhealthy.

From these facts we see that the two great essentials for a healthy, prosperous world are sunlight and a clean bright atmosphere; but, unfortunately, we ourselves are the greatest enemy to these, as in the practice of what in grim irony is called "civilization" we dim the one and pollute the other. It is the chance possession of our great coal-fields which has given our country its proud position among the nations; but the very abundance of coal has engendered such habits of profligate waste in its consumption that the atmosphere in our large towns has become a national scandal.

The principal source of the cloud that hangs over our big towns—cutting off the direct rays of the sun and ruining health—varies with the locality. In the South of England, it is the domestic grate, using bituminous coal, which is responsible for the major portion of this pollution of the atmosphere; while farther north, in the great manufacturing centres, it is the factory shafts which emit the pall of black smoke that aids in shortening life and killing vegetation, and which begrimes, and finally helps to destroy, our public buildings. But it is a certain fact that domestic smoke is produced throughout the length and breadth of the land, whereas the factory chimney concentrates its attention on the more limited area of manufacturing districts.

Of our coal supply, about 36 million tons are used annually as domestic fuel in this country; and it is no exaggeration to say that close upon 12 per cent. of this, or 4,320,000 tons, have been discharged into the air as the mixture of steam, soot, tar, ash, and unburnt gas that we call "smoke." If this coal were treated in our gas-works, the wasted 12 per cent. would be distilled out and recovered as valuable products, tar and ammoniacal liquor—two substances for which there

is an unlimited market at a good price, as the tar would yield benzol to make up for the shortage of petrol, and the remainder of it would be available for making dustless roads; while the whole world is demanding sulphate of ammonia made from the liquor as a fertilizer. If this were done, we should have as fuels coke which could easily be made of a character better fitted for domestic fuel, and coal gas, which is the best and most economical fuel that could be employed.

Smoke in itself is harmful enough; but it also brings in its train a 50 per cent. increase in the number of fogs from which we suffer, and renders those due to other causes more lasting and more virulent. The effect of smoke on our health in large towns is deplorable. The vitalizing effect of the sun is cut off, diffusion hindered and checked, and the stunted growth and consumptive tendencies of the poor in our big cities are an outward indication of the mischief that arises. Plant life tells its own tale, and is an indication of the effect on man.

It must be borne in mind that the smoke question not only affects the well-being of the country, but also implies a waste of fuel so great that, with the problem of failing coal supplies looming on the horizon, it behoves us to make a national matter of it, not only from a hygienic but also from an economic point of view. Indeed, the whole question of fuel economy is so closely allied to the problem of smoke prevention, that it is impossible to consider the one without the other; and if only rational methods of heat production were adopted, economy in fuel, improvement in health, and cleansing of the atmosphere would follow.

Sale of Stocks and Shares.

Two new issues of capital were prominent features in the sale conducted by Messrs. A. & W. Richards at the Mart, Tokenhouse Yard, E.C., last Tuesday. The Aldershot Gas, Water, and District Lighting Company offered £4000 of "C" consolidated stock, carrying the maximum dividend of 5 per cent.; and it was all disposed of at £95 per £100 of stock. A similar nominal amount of 4 per cent. consolidated preference stock of the Company fetched from £82 10s. to £83 per £100. The Uxbridge Gas Company had for disposal £6000 of consolidated stock, and some 4 per cent. perpetual debenture stock. The former ranks for a standard dividend of 5 per cent., subject to the sliding-scale; but similar stock carries £6 2s. 6d. per cent. It was all sold at from £119 to £121 per £100. The debenture stock fetched £95 per cent. The remaining stocks and shares were being sold by order of executors. A few fully-paid "D" shares (£25) in the Dorking Gas Company, on which 5 per cent. has been paid ever since they were issued, realized from £24 to £25 5s. each. Next came some "A" original £5 shares in the St. Margaret's Gas Company, on which 6 per cent. has been paid for the past eight years. They were placed at from £5 to £5 5s. each, *cum div.* The last lots consisted of £5 ordinary shares in the Wyvenhoe Gas Company, Limited; and they fetched £4 apiece—the purchasers taking the year's dividend accruing from April 1, 1912.

NOTTINGHAM GAS EMPLOYEES AND TRADE UNIONISM.

[From a Local Correspondent.]

The tirade against the Nottingham Corporation has assumed another significant phase in the skilfully-exploited agitation devised primarily in the suggested interests of those who are engaged in the gas-works. Mr. Will Thorne, M.P., in the intervals of attendance at Westminster, has paid special attention to the solidification of the ranks of the Gas Workers and General Labourers' Union located within the area covered by the Nottingham Corporation. Anathemas have been launched against the non-unionists who prefer independence of status to being driven into the trade union compound; but efforts to bring the obdurate to book having proved disappointing, further steps are being taken.

A meeting was held last Wednesday, to which not only the representatives of the gas workers, but of the various other branches of the Corporation service had been summoned. In the anticipation of the possibility of extending the attack all along the line, the gas-workers' case was made the basis of a pronouncement which, if it means anything, means that the Nottingham Corporation have no right to engage labour from outside the trade union phalanx. Mr. Geo. Bell, the Chairman of the Nottingham and District Trades Council, presided at the gathering, at which there was a recrudescence of the old ailment suggesting the carefully nurtured view that non-unionists are favoured to the disadvantage of those who are within the accredited fold. A decision to hold propaganda meetings insisting upon conventional adherence of all Corporation workers ensued as the inevitable outcome of many speeches, from the doubtful privilege of hearing which representatives of the Press were rigidly excluded. Sufficient, however, was subsequently voluntarily forthcoming to support the conclusion that the attack is to be developed on general lines, and that in particular the Gas Committee are not to be allowed to perpetuate the idea of non-unionist hands being employed, when the trade union quidnuncs have otherwise decreed. Bumptiousness of this cheap character is scarcely likely to be permitted to interfere at all with the continuity of policy under which the large majority of Nottingham gas workers have never for a moment suggested ground for material complaint.

The New Reservoirs for Sheffield.—Referring to the decision of the Sheffield Corporation to construct by administration the new water reservoirs alluded to in the "Journal" last week (p. 198), the "Sheffield Daily Telegraph" said: "The experience gained in the construction of the Langsett reservoir, and the ability Mr. Terrey [the General Manager] has displayed in all these matters, point to the conclusion that the safest and cheapest course will be to carry out the scheme by administration."

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SLOUGH DISTRICT COUNCIL AND THE GAS COMPANY.

Opposition to the Company's Bill Withdrawn.

At the Meeting of the Slough Urban District Council on Monday last week, the Parliamentary Committee presented a report on the subject of the Council's opposition to the Bill promoted by the Slough Gas Company. The Committee said that, having carefully considered the Bill, and carried out further negotiations with the promoters, they recommended that a letter of Messrs. R. H. Barrett and Son, dated March 12, 1913, which accompanied the report, be accepted as an undertaking and agreement on behalf of the Company not to oppose a Bill in Parliament if promoted by the Council with a view to purchase, and to reduce the price of gas. The Committee considered that further opposition to the Bill would not be advisable; and they recommended that it should be withdrawn. As a reply was required at once, they gave instructions that the petition of the Council against the Bill should not be proceeded with.

In the course of the letter, which was written without prejudice, the writers said: "(1) If your councillors introduce a Bill in Parliament within two years from this date for the purchase of the undertaking of the Company on the same terms as are contained in section 51 of the Slough Water-Works Act, 1910, with an enlargement of sub-section (3) so as to make due provision for the greater number of Directors and their remuneration, the Directors agree not to oppose such Bill. (2) As to the price of gas, the Company are prepared to meet your Council's suggestion by making an immediate announcement of a reduction of 2d. per 1000 cubic feet, to take effect as from and after the current half year, ending the 30th of June next, and will do their best to effect a further reduction of 1d. as from the end of the then ensuing half year; thus reducing the price to 3s. 6d. per 1000 cubic feet as from the 1st of January of next year. (3) The Directors do not see their way to interfere with the statutory discretion given to the shareholders in the election of Auditors, but are willing to furnish your Council with copies of the accounts as supplied to the shareholders, and it will be open to the Council to submit the same to any accountants, chartered or otherwise, should they at any time think proper to do so."

The presentation of the report gave rise to some discussion; but in the result the Committee's recommendation was adopted with one dissentient.

Tarapaca Water-Works Company, Limited.—The net profit of this Company for the year 1912 amounted to £51,320, which, added to the balance brought forward (£10,770), and allowing £1664 for income-tax, made a total to the credit of the profit and loss account of £60,425. An interim dividend was paid on the 2nd of October last at the rate of 8 per cent. per annum, absorbing £12,800; leaving £47,625 to be dealt with. The Directors recommend a final dividend of 4 per cent., making 8 per cent. for the year, and the placing of £25,000 to the reserve fund. This will leave a balance of £13,025 to be carried forward.

NOTES FROM SCOTLAND.

From Our Own Correspondents.

Saturday.

Edinburgh.—The operations of the Electric Lighting Committee of the Edinburgh Town Council are proceeding apace, and the incoming year should witness a considerable development of the service throughout the city. The estimates for the year 1913-14 have been adjusted for the approval of the Town Council; and these show an expenditure of £80,265, as against an estimated expenditure for 1912-13 of £73,470, and an actual expenditure in 1911-12 of £69,640. The estimated revenue for 1913-14 is £142,660, compared with £135,410 for 1912-13, and an actual revenue in 1911-12 of £131,678. For the year 1913-14, the increase in the price of coals involves an extra expenditure of £6000—the figure being £30,000, against £24,000 last year.

The Edinburgh and Leith Corporations Gas Commissioners are very actively carrying out their policy, which has been so fruitful, of illustrating the utility of gas for purposes of cooking. To-day a cookery demonstation and gas exhibition will be opened in the Free Gardeners' Hall, and will remain open until Friday of this week. The demonstrations are by Mrs. H. C. Gray.

Glasgow.—As usual, after the extension of boundaries, various questions have cropped up regarding the levying of charges upon the new areas. It is claimed that promises were made by the Corporation that there should be no increase of the rates in these areas for ten years after the extension of the city. Special charges for lighting and cleaning private streets and courts, and for the maintenance of lamps in private streets, have been made within the former boundaries, and the City Assessor has been charging similar rates for the new areas; but the owners claim that the rates were to be stereotyped for the next ten years, and that they included these special charges. The matter is to come by appeal before the Sheriff.

Aberdeen.—The annual inspection of the gas-works by members of the Town Council took place last Wednesday. The company were conducted round the works by the Gas Engineer (Mr. Samuel Milne) and his Assistant. At the conclusion of the inspection, the party adjourned to the Engineer's office, where refreshments were served. In the absence of the Lord Provost, Bailie Barron occupied the chair, and proposed the health of the Gas Committee. The Gas Department were making vast strides in regard to additions of plant, and he hoped the consumption of gas would continue to encourage the same policy which the Convener had very successfully carried out up to that time. In Mr. Sangster they had an ideal Convener—a thoroughly practical man in every way. Mr. Sangster, in acknowledging, said that the past year had been a record one in the history of the Gas Department. Dealing with new plant, he said that towards the close of last year the Committee had under consideration an addition to the retort-plant, and a

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month or two ago they came into possession of plant sufficient to make a million cubic feet of gas per day. Last winter the demand for gas exceeded the capacity of the works, and he thought this was not a safe position to be in. However, with a large amount of storage, they were able with Saturday afternoon and Sunday labour to tide over the difficulty; but if any accident had occurred, they would certainly have been in a very bad predicament indeed. Another addition had been required in connection with the exhausters, and tenders had been accepted for new plant. Both retorts and exhausters they expected to be ready in time for next winter's demands. A further addition they proposed to make shortly, and to which the consideration of the Committee would soon be directed, was the extension of the coal storage accommodation. The increase in the output of gas this year was expected to be between 70 and 80 million cubic feet; and for this purpose enlarged coal storage was required. An extension was also needed in the case of the workshops. The management was in very capable hands, and Mr. Milne had gathered round him a staff of which he might well be proud. Mr. Milne, replying on behalf of the staff and himself, expressed his thanks to the members of the Town Council for their kindness. Speaking with reference to the growth of the department, he said that the number of free cooking appliances now in use in the city was 11,700; while the heating appliances numbered 4300. The function terminated with a vote of thanks to the Chairman.

The workers at the Corporation gas-works are considering the advisability of applying for an increase in wages of 4s. per week. The retort-house workers want an increase from 4s. 6d. to 6s. per shift. It is claimed that the present rate paid in Aberdeen is from 3s. 6d. to 5s. 6d. per week less than that paid for similar work in such undertakings farther south.

Arbroath.—Mr. Andrew Fife has secured the contract for the retort-bench foundations in connection with the introduction of new plant at the gas-works.

Burntisland.—Mr. Alex. Ross, who has been for over forty years the Manager of the gas-works, which at one time were the property of the North British Railway, but which have now been for many years in the hands of the town, has been paid a graceful compliment by Provost Kirke, who said that the Corporation had to congratulate themselves upon the efficiency which Mr. Ross had shown in their affairs. He trusted Mr. Ross would be long spared and have good health so that he could continue to give his help to the community. When he (Mr. Ross) first went to Burntisland, the price of the gas was 7s. 6d. per 1000 cubic feet. This figure had been reduced to 3s. 4d.; but at one time it was as low as 2s. 11d. The make had increased from a few million cubic feet up to 27 millions; and many extensions had been carried out at the works, including a new holder only a few years back. At the present time extensions were being made to the retort-bench on Messrs. R. & G. Hislop's system. The burgh boundaries had recently been extended; and this would mean the laying of a number of mains to cover the new district.

Dundee.—The examination of Mr. Yuill, the Gas Manager of Dundee, at the boundaries extension inquiry, recalls the fact that when Mr. Yuill first went to take charge of the Dundee Gas-Works the price of the gas there was higher than that charged in Broughty Ferry. This was at the time put down largely to the very heavy capital charges with which the Dundee works were saddled. Since then, however, a large capital expenditure has been incurred, and yet the price has been reduced, until now it is much below that of Broughty Ferry. The argument that the increased rates in the different districts will be compensated for by the lower price for gas is only true so far as the consumers of gas are concerned, and is no doubt an excellent argument for those who are obliged to use a large quantity of gas for business or other purposes, but is not much argument to the man who does not require this commodity.

Elie.—At a meeting of the Town Council on Friday evening, it was resolved to introduce the pressure-wave system of street lighting, and to have it in complete operation for next lighting season.

Forfar.—Bailie Lamb, the Convener of the Gas Committee, mentioned at the Town Council meeting the very bad state of the gasholder. The question had been raised three years ago, but the matter had been passed over and nothing done. After Mr. Graham, the new Manager, had agreed that the matter was urgent, the Council decided to invite estimates for the work.

Inverurie.—Ex-Bailie John Low has been unanimously appointed Chairman of the Inverurie Gaslight Company, Limited, in room of the late Colonel Jackson. Ex-Provost Smith, one of the Directors, who presided at the meeting, referred in feeling terms to the valuable services rendered by their late colleague during the sixteen years that he had been a member of the directorate, for nine years of which he had been Chairman.

Kirkcaldy.—The question of the plebiscite on the gas-works extensions was before the Town Council at their meeting on Monday last, when Councillor Garnock moved "That the plebiscite be delayed until a resolution has been adopted for the reconstruction of the gas-works in accordance with the scheme and plans prepared by Mr. Kincaid, or for the construction of new works on another site; and, further, that it be remitted to the Gas Committee to consider what improvements or extensions are actually necessary, in order that they may be able to carry on the business satisfactorily and economically for a period of at least four or five years." After some discussion, the motion was unanimously agreed to.

Kirkintilloch.—The Gas Committee have recommended the erection of a new gasholder to supplement the present one at the gas-works, at a probable expenditure of £4000. The new holder is to be capable of containing 150,000 cubic feet. The capacity of the present holder is nominally 500,000 cubic feet; but its full extent has not been able to be utilized. Owing to colliery workings, the site is not all that could be wished for a gasholder; and expert opinion is to be obtained before the Gas Committee proceed with the work. On this condition, the Town Council agreed to the proposal.

Moffat.—The Town Council have just unanimously instructed

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Mr. W. E. Townsend, to submit, free of cost, plans, specification, and estimates for a scheme of electricity, on the understanding that, if the scheme is adopted, he is to be appointed Engineer to carry it out. A plebiscite of the ratepayers is to be taken before the electric light is installed. Meantime, the Gas Company should push matters, so that the feeling of the ratepayers should be in their favour.

Montrose.—The Gas Company have just held a successful gas exhibition. Messrs. Fletcher, Russell, and Co., Limited, showed a large collection of appliances in sizes suitable to the needs of either a large or a small family. Messrs. R. & A. Main had on view a "St. Nicholas" fire and a variety of cookers, radiators, &c. The hall in which the exhibition was held was brilliantly illuminated by two-light "Dreadnought" lamps of Messrs. George Hands and Co., who showed their new "Vitreosil" radiator. Cookery demonstrations were given each afternoon and evening by Miss E. M. Dods. The whole of the arrangements were made by Mr. James Mitchell, the Company's Engineer and Manager.

Prestwick.—The Ayr Corporation and the Prestwick Town Council have agreed generally to the extension of the lighting area of the former so as to include the Prestwick and Alloway districts; and a Provisional Order is to be applied for to cover this, so that the supply of electricity can be extended. The matter has been continued until the Committee have completed their report.

St. Andrews.—Under the auspices of the St. Andrew's Gas Company, Limited, an exhibition of lighting and heating apparatus was opened in the Christian Institute on Tuesday.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *April* 19

Sulphate of Ammonia.

There is nothing new to report in the market for this article, and throughout the week the trend of values has continued to be in a downward direction. The demand for consumption in the United Kingdom has been fairly good, but fresh orders for export have been rather scarce. The closing quotations are £13 12s. 6d. per ton f.o.b. Hull, £13 15s. per ton f.o.b. Liverpool, and £13 17s. 6d. per ton f.o.b. Leith. No first-hand transactions have been reported in the forward position this week, although manufacturers are now willing to sell for July-December delivery at about prompt prices. Dealers are said to be still offering abroad at a discount over this period.

Nitrate of Soda.

The tone of this market is unchanged, and holders continue to quote 11s. 10½d. per cwt. for ordinary and 12s. for refined quality, on spot.

LONDON, *April* 21.

Tar Products.

The markets for tar products have been very quiet during the past week. Pitch does not appear to be quite so strong for the prompt position; but manufacturers are still firm in their idea for the forward. Ninety per cent. benzol maintains its price; and there is a good inquiry for both prompt and forward delivery. In some quarters, better prices are reported to have been paid. Solvent naphtha is quiet, though there is no further lowering in the value. Heavy naphtha is in fair demand. Business in crude carbolic is reported at lower figures, and consumers are not at all anxious to purchase for the forward position. Creosote is fairly steady, and the price is well maintained.

The average values during the week were: Tar, 29s. 9d. to 33s. 9d. Pitch, London, 47s. 6d. to 48s.; east coast, 47s. to 47s. 6d.; west coast, Clyde, 47s. to 47s. 6d.; Manchester, 46s. 6d. to 47s.; Liverpool, 47s. to 48s. Benzol, 90 per cent., naked, London, 1s. to 1s. 0½d.; North, 11½d. to 1s.; 50-90 per cent., naked, London, 10d. to 10½d.; North, 10d. Toluol, naked, London, 10½d. to 11d.; North, 10d. to 10½d. Crude naphtha, in bulk, London, 5½d. to 5⅝d.; North, 5d. to 5⅛d. Solvent naphtha, naked, London, 1s. 0½d. to 1s. 1d.; North, 1s. to 1s. 0⅛d. f.o.b. Heavy naphtha, naked, London, 11½d. to 1s. f.o.b.; North, 10d. to 10½d. f.o.b. Creosote, in bulk, London, 3½d. to 3⅝d.; North, 3½d. to 3⅝d. Heavy oils, in bulk, 3½d. to 3⅝d. Carbolic acid, casks included, 60 per cent., prompt, east and west coasts, 1s. 5d. to 1s. 5½d. Naphthalene, £5 to £9; salts, 50s. to 55s., bags included. Anthracene, "A" quality, 1½d. to 1¾d. per unit, packages included and delivered.

Sulphate of Ammonia.

The market is quiet, and there has been a decided weakening during the past week—in fact, for the forward position, business has been done at prices ranging from 3s. 6d. to 5s. per ton lower than to-day's quotations. Outside London makes are £13 2s. 6d. to £13 3s. 9d.; Leith, £13 17s. 6d. to £13 18s. 9d.; Hull, £13 15s.; Liverpool, £13 15s. to £13 16s. 3d.; Middlesbrough, £13 15s.

COAL TRADE REPORTS.

Northern Coal Trade.

The coal trade is firm, owing mainly to the lessened output of some of the collieries—the working having been rather irregular of late. The production has in some instances been appreciably reduced. In the steam coal trade, best Northumbrians are from 15s. 10½d. to 16s. per ton f.o.b.; second-class steams are from 15s.; and steam smalls from 11s. 3d. to 12s. 6d. The demand for the latter sort is keen, and the output not quite so full, owing to the less regular working. In the gas coal trade, there is also a shortage of the output, which does not enable some of the collieries to meet all their heavy contracts as rapidly as they could wish—an unusual occurrence in the gas coal trade at this season of the year. Best Durham gas coals are firm at 16s. per ton f.o.b.; and for second-class kinds about 15s. is the current quotation. For "Wear specials," from 16s. to 16s. 6d. per ton f.o.b. is quoted; but most of these prices are varied a little owing to the position of the collieries, or the time of delivery desired. There are no reports of

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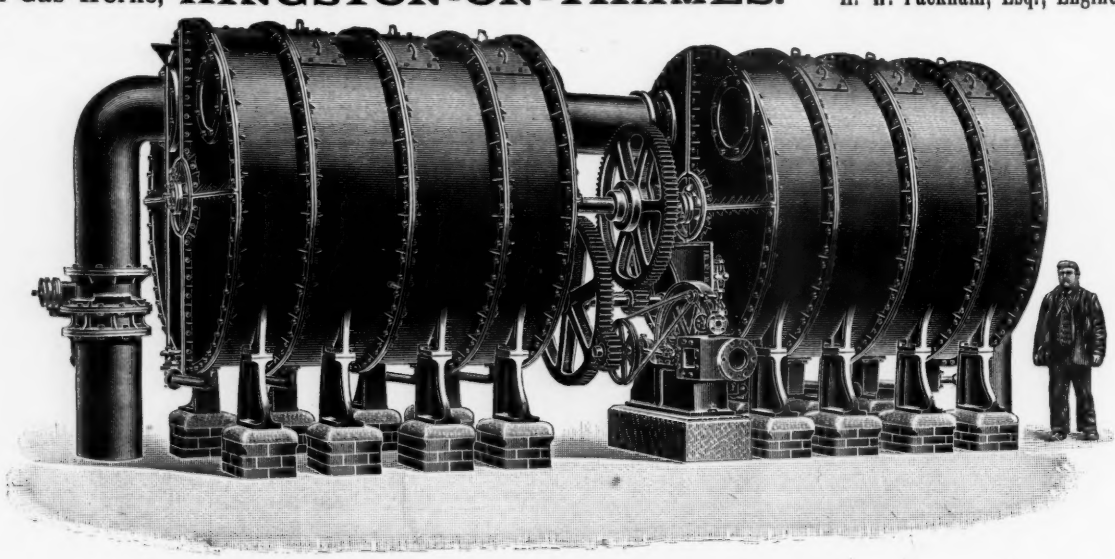

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new contracts to any amount in the last few days; but a few sales and cargoes for ports in the Mediterranean are believed to have taken place at a basis near that of the current prices mentioned above. Gas coke is steady, though there is a little less being sent to some Continental centres; the quoted figure being about 17s. per ton f.o.b.

Scotch Coal Trade.

There is no alteration in the general tone of the reports from the various Scotch coal-fields, and business continues active, with prices ruling steady. On Friday, on the Glasgow Coal Exchange, the following were the approximate prices quoted: Steam coal, 13s. 6d. to 14s.; splint, 14s. 9d. to 15s. 3d.; ell, 13s. 9d. to 14s. 3d.; trebles, 13s. 3d. to 13s. 9d.; doubles, 13s. 3d. to 13s. 9d.; and singles, 13s. 3d. to 13s. 9d., f.o.b. Glasgow.

Widnes Gas Undertaking.—As a result of the consistent increase in the consumption of gas at Widnes, the Town Council on Friday decided to extend the gas-works, and accepted the tender of Messrs. Drakes Limited, of Halifax, for £28,000, for reconstruction of the gas-making plant and the installation of labour-saving apparatus. The total cost of the work will be £36,000. Alderman T. Smith (the Chairman of the Gas Committee) explained that the cost of carbonizing would be reduced from 3s. to 1s. per ton of coal carbonized. The works, while producing the cheapest gas in the country, had yielded an annual profit of £4000; and it was estimated that with the economies to be effected the profits would in future reach £6000 per annum. It was, moreover, anticipated that the presence of naphthalene—which had proved such a bugbear to the Committee—would be very largely obviated.

Coke-Oven Bye-Products in South Russia.—The last number of the "Chemical Trade Journal" contained the following particulars of the bye-products obtained in the production of coke during the past year in South Russia. The average number of coking-ovens at work per month in the Donetz basin was 436, with recuperative apparatus, out of a total of 720. In the course of the year, there was a rapid increase in the production of primary bye-products in South Russia compared with 1911. The quantity of coal tar obtained was 1,180,466 poods—*i.e.*, 507,273 poods, or 75·35 per cent., more than in 1911. The quantity of ammoniacal liquor obtained (25 per cent.) in 1912 was 619,919 poods—*i.e.*, 370,797 poods increase, or about 2½ times the production of 1911. In secondary bye-products there was a particularly large increase in the production of sulphate of ammonia, which last year amounted to 244,606 poods—*i.e.*, 212,793 poods, or 7·7 times that of 1911. The smallest increase, though still an important one, was that in the production of heavy oil, particularly pitch. The quantity of heavy oil produced was 233,330 poods—*i.e.*, 73,187 poods, or 45·70 per cent., more than in 1911; the figures for pitch being 290,996 poods—an increase of 88,074 poods, or 43·40 per cent. The production of ammonia spirit amounted to 6437 poods—*i.e.*, more than twice that of the preceding year.

East Cowes Water Supply.—A proposed loan of £986 for boring for water was investigated at a Local Government Board inquiry at East Cowes last Wednesday. There was considerable opposition, as the "Burnt House" site, from which the supply will, it is hoped, ultimately be obtained, is eight miles from the district; and it was urged that the estimated outlay would be £20,000 instead of £11,800. It was stated that the site was 200 feet square, and that £400 would have to be given for it; and if the experiment was successful, a 200-feet well would be sunk, a reservoir erected capable of holding 100,000 gallons, and machinery purchased capable of lifting 15,000 gallons per hour. The estimated quantity of water required is 150,000 gallons per day.

Rochdale Gas and Water Departments.—The profit on the year's trading of the Rochdale Gas Department has broken all records—amounting to £23,654, which is £3348 more than the net surplus last year. For the year just ended the income was £103,449, against £97,525 in 1911-12. Working expenses amounted to £68,420, or £2709 more. Interest and sinking fund charges are £11,375. At their meeting last Wednesday the Gas Committee decided to grant £16,000 to the rates, to place £6000 to renewals fund, in accordance with a special recommendation of the Local Government Board, and to carry the balance of £1654 to reserve. A proposal to grant £17,654 to the rates was defeated. The water-works show a deficiency on the year of £4832, or £534 more than twelve months ago.

Primitiva Gas Company of Buenos Ayres, Limited.—The accounts of this Company for the year ended Dec. 31 show a total to the credit of the profit and loss account of £334,651, to which is added the amount brought forward, £51,937. The Directors propose to pay a final dividend of 4s. 6d. per share (less tax), making a total distribution of 8 per cent. for the year on the ordinary shares, to place to the pension fund £2000, and to the Retiro works amortization account £35,000; leaving to be carried forward £40,480. The Directors state that the profits were again unfavourably affected by the increase in the price of coals and materials, the strikes and labour troubles in Buenos Ayres and in this country, and the excessively high rates of freight. The increase in the quantity of gas sold during the year was 5·75 per cent.

Co-Partnership Scheme for Swansea Gas Employees.—The Swansea Gas Company have put into force the powers they have obtained under their Act of 1911 by forming a co-partnership scheme; and we learn from the Engineer (Mr. George Andrews) that, the scheme having been put before the men and explained to them, the result has been that the whole of the employees and officials of the Company, with the exception of eleven who are ill, have joined it. In order to celebrate the occasion, and to give a good start to the scheme, the Directors have sanctioned one year's full bonus to be credited to each co-partner on the 30th of June next. A deputation, representing the different departments and occupations of the men, had an interview with the Directors last Thursday, and expressed their thanks for allowing the scheme to be put in force, and were unanimous in recognizing the benefits they anticipated it would confer upon them.

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The Recent Gas Strike in Sydney.

Mr. A. C. Scrivener (Birmingham) has forwarded the following extract from a letter dated the 10th ult., received by him from his son in Sydney. It was written just after the strike, and contains an interesting comment on labour unrest in the city. "Saturday night [March 8] saw the end of the gas strike. For eight days we have been more or less without gas. Cooking was a matter of oil-stoves, or the old Billy fire in the back yard; lighting a matter of candles or oil-lamps; street and shop lighting (save for such districts as were supplied by electricity) non-existent. For the last few days the art of making gas has been performed by free and volunteer labour—the Lord Mayor of Sydney doing his four-hour shift of stoking at the furnaces, while the Union stood out for their additional 'bob' a day, and the hundred industries dependent upon gas power lay idle. You at home in England do not yet know the power of the working man and his Unions as we know it. You have great strikes, it is true, and their causes generally are great; but they are not senseless, frivolous things like we have to put up with. Still, you are getting on in the same direction when a tremendous railway hold-up is threatened because of one guard. That is *almost* Australian. We narrowly averted all the ferries going on strike last week also, because they thought the Arbitration Board was getting on too slowly. This would have meant practically a hold-up of all the North Shore residents. They simply go on holding-up industry after industry. Get in free workers, and they will mob them when they come out; keep them inside, and there cater for them, and the caterers' assistants will come out. There is only one cure, and that is to do without the article they make. The law offers every facility for arbitration; and if people would simply demand that the Labour Government should do its duty to protect the law-abiding majority, strike rule would soon cease."

Halstead Gas Company, Limited.—The report of the Directors of this Company (of which Mr. J. T. Jolliffe is Chairman) for the past year shows a profit of £710 on the revenue account. An interim dividend of 5 per cent. per annum was paid in June, and a further dividend at the same rate has been declared. A large number of new customers came upon the books, there was a 10 per cent. increased output of gas, and considerable additions to the stoves let on hire.

Large Imports of Petrol.—According to the "Motor," tales of the "shortage of petrol supplies" do not seem to be borne out by the official returns of the Customs authorities. Our contemporary says: "The quantity of motor spirit imported into this country during the three months ended the 31st of March (after deducting the quantity re-exported) was no less than 23,171,471 gallons; whereas the imports for the like period in previous years were: 1911 (first three months), 14,447,400 gallons; 1912 (first three months), 14,903,951 gallons. The increase is thus well over 50 per cent., and it is hard to believe that the increase of motor traffic in the twelve months has anywhere approached this figure."

Claim under the Workmen's Compensation Act.

At the Bow County Court, last Wednesday, before his Honour Judge Smyly, K.C., sitting with Dr. Bate as Medical Referee, Leo West, a gas-fitter's mate, was the applicant in a Workmen's Compensation Act case against the Gaslight and Coke Company; the amount asked for being seventeen weeks' half-pay, at 14s. 6d. per week. Mr. W. A. Metcalfe appeared for the applicant; Mr. R. Vaughan Williams represented the respondents. According to the evidence of the applicant, he had worked for the Company for nine years, and had rarely been off for illness. On the 23rd of November last, he was burning-off a steam-trap from under a gas-engine, and while he was doing it there was an explosion, the full force of which he received in his face. Whatever was in the engine dug holes, like pinholes, all over his face and neck, and badly burnt him. He went to a doctor, and laid up for a week, after which he returned to work. He only did a week, however, as he found he was in such a highly nervous state he was not only a danger to himself but to his mates; so he gave it up. He sent several certificates to the Company saying what he was suffering from; and finally he returned to work in January. His fitter allowed him to take things easily, although he did not feel capable of working; and then one Saturday afternoon the fitter was suspended for breaking one of the most stringent of the Company's rules. Applicant was also suspended for the half-day. On the following Monday he again felt bad; and finally he decided to make a claim. He was told he was suffering from traumatic neurasthenia, or shock to the nervous system; but he now felt quite capable of going back to work. He had received 6s. 6d., and that was all. Mr. Vaughan Williams said compensation money was not payable the first week; so the Company made a compassionate allowance to all injured workmen, of half what they would receive from a club—viz., 6s. 6d. They had kept to this rule unfailingly. Dr. Harcourt corroborated the evidence of the applicant, that he was incapable of doing his work. He found mitral trouble. Sir George Hastings gave evidence for the respondents. He said he had dismissed from his mind all idea of traumatic neurasthenia, as the man seemed capable of working when he saw him. He was willing to admit, however, that the explosion and shock would accentuate the mitral trouble, and lengthen the period of applicant's recovery from a slight accident. After consulting with the Medical Referee, his Honour said it was clear, from the evidence of Sir George Hastings, that the man had been genuinely ill. Sir George said himself that the explosion would accentuate the mitral trouble; and the Court of Appeal had decided that the bursting of a blood-vessel through exertion when working was an accident within the Act. He should award the applicant 14 weeks' pay at 14s. 6d. a week, and allow costs on the "C" scale.

Athens Water Supply.—According to the correspondent of "The Times" at Athens, the Minister of the Interior has introduced in the Chamber a Bill for solving the important question of increasing the supply of drinking water at Athens and the Piræus by utilizing the waters of Lake Stymphale or of a small river in Bœotia.

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Gas Poisoning Fatality at Sheffield.

At an inquest on a Sheffield youth who was poisoned by coal gas, it was stated the family had moved into a fresh house on the Saturday afternoon, and when a light was required that night the father fixed up temporary fittings in the kitchen and front bedroom. He then turned on the gas at the meter with a spanner, as the tap was turned off tightly. He looked to see if there was a gas-pipe in the back bedroom (where deceased went to sleep), but did not notice one. On the Sunday, the youth was not well; and he was last seen alive when he went to bed that night. Next morning he was discovered dead in bed, with the room full of gas; the doctor stating that there was an unplugged gas-pipe, with gas issuing from it, directly over deceased's head. The father stated that during the week-end he did not smell any gas; but since the catastrophe he had found the unplugged pipe, which stood out only about a quarter-of-an-inch from the wall. Albert Lane, a fitter employed by the Sheffield United Gas Company, said that earlier in the month he received an order to go to the house in question, which was then empty, and remove the gas-fittings. He accordingly did so, and did not do anything to the pipes. He turned the gas off at the meter very tightly. In reply to the Coroner, witness admitted that he had made a mistake in not capping the pipe, while he also expressed his ignorance of part of Rule 26 in the Company's rule books, which stated that "when a fitter takes down any fittings, he must in all cases (in addition to turning off the main tap) either cap with the brass caps provided for that purpose, or securely plug, the pipe-end." He further admitted that when he removed the fittings he was short of caps in his tool-bag. After an absence of ten minutes, the Jury returned a verdict that deceased died from coal gas poisoning; that Albert Lane was negligent, but not criminally so, in not capping or plugging the gas-pipe; and that there was carelessness on the part of the father in not making more careful examination of the bedroom so as to discover the gas-pipe.

A new water supply provided for the parish of Bocking by the Braintree Rural District Council was inaugurated last Saturday week; a large company attending the formal opening of the pumping-station at Church Street. The engine was started by Mrs. S. A. Courtauld; and subsequently Mr. H. H. Sands (of Messrs. Sands and Walker, of Nottingham) gave particulars of the scheme, which has cost £9300. The water is pumped from a bore 325 feet deep, and 164 feet into the chalk; and the machinery, which is all in duplicate, is capable of raising 20,000 gallons per hour. The water is carried by a rising-main to a tower on high ground, and stored in a tank with a capacity of 64,000 gallons, equal to two days' normal supply. There are 9 miles of mains, with hydrants, stop-valves, and fire alarms. Dr. Thresh, the Essex County Medical Officer of Health, congratulated Mr. Sands on the successful completion of the works. Tea was served; and the water-tower was then inspected.

APPLICATIONS FOR LETTERS PATENT.

8080.—Banon, A., "Regenerative furnaces." April 7.
8087.—M'Lachlan, R. W., "Gas-governors." April 7.
8099.—Germann, A., and Braach, P., "Gas-cookers." April 7.
8104.—Nash, L. H., "Water-meters." April 7.
8126.—Hart, W., "Gas-producers." April 7.
8150.—Huggins, W. H. & J. M., "Pipe-couplings." April 7.
8194.—Picard, C. G., "Lamps." April 7.
8206.—Peebles, W. C., "Gas-governors." April 8.
8237.—Mitchelite Petrol Air-Gas System Company, Ltd., and Purvis, C. H., "Fluid-pumping mechanism." April 8.
8258.—Davis, G. H., "Acetylene generators." April 8.
8274.—Kahn, R., "Gas-igniters." April 8.
8296.—Mohn, T., "Multicylinder gas-engines." April 9.
8348.—Bugnon, A., "Burners." April 9.
8365.—Potter, W. G., "Burners and mantles." April 9.
8375.—Smith, E. C. B., "Stop-valves." April 9.
8382.—Vidali, P., "Automatically closing valves." April 9.
8456.—Thompson, W. P., "Inverted gas-lamps." A communication from the General Gaslight Company. April 10.
8474.—Tooth, L. F., "Melting furnaces." April 10.
8481.—Reineke, W. A., "Meters for use with acetylene generators." April 10.
8497.—Bastian, C. O., "Geysers." April 10.
8498.—Alexander, W., and Pinchbeck, Ltd., "Gas-meters." April 10.
8521.—Milne, J., and Son, Ltd., and Fox, T., "Coin-freed device." April 11.
8523.—Spencer, W. E., and the Spenhow Valve Company, Ltd., "Cocks." April 11.
8524.—Drakes, Ltd., and Dobson, A., "Vertical retorts." April 11.
8525.—Toogood, H. J., and Dempster, R., and Sons, Ltd., "Extracting or discharging mechanism for gas-retorts." April 11.
8532.—Thorp, T., F., & H. T., "Incandescent gas-lamps." April 11.
8549.—Epstein, G. J., "Fuel and bye-products." April 11.
8575.—Symonds, E., "Manufacture of fuel." April 11.
8639.—Price, T. E., and Turner, F., "Inverted burners." April 12.
8658.—Keller, H., "Measuring the quantity of fluid pumped." April 12.
8664.—Simmance, J. F., and Wernham, W. G., "Registering-mechanism of meters." April 12.
8673-4.—Edmunds, H., and Bonecourt Surface Combustion, Ltd., "Combustion of combustible mixtures." April 12.
8684.—Cosway, H. C., and the United Alkali Company, Ltd., "Production of nitration products from coal tar." April 12.

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BIRMINGHAM & LONDON.

GAS COMPANIES' STOCK AND SHARE LIST.

The Stock Exchange has had a week which may be characterized as free from troubles on the one hand and not wholly devoid of favourable points on the other. But, somehow or other, markets did not seem to make much out of the situation; and indeed (with the exception of Home Rails, which achieved moderate advances) the leading departments lost ground on the whole. International *pourparlers* had a pacific complexion, and on Thursday relief came from the incubus of a 5 per cent. Bank rate which had ruled for six months; but the markets seemed to care for none of these things. The opening on Monday was pretty fair, and a steady tone prevailed throughout the day. Consols were steady, Rails were more lively and pushed their prices up a little, Americans looked up, and Foreign were firm. Tuesday's business was quiet; but the favourable tone was not impaired. Consols rose $\frac{1}{8}$, and Rails maintained a moderate advance; but Americans were in a bad way. Wednesday opened inclined to be dull, and never reached better than a very moderate tone with restricted business. Government issues were featureless; Rails uneven, with as many ups as downs; and Americans still drooping. Thursday was a lethargic sort of day; and the change in the Bank rate (already foreseen) did not quicken a pulse. Markets in general were steady and scarcely changed. Friday did bring movement; but it was all in the wrong direction, and markets showed a general give-way all round. Business was dull and quiet, except for some amount of profit-snatching; and a failure was announced. Gilt-edged were weak, and Consols fell $\frac{1}{8}$ for money and account; while all the chief departments fell back more or less. Saturday was no better. It was very quiet and spiritless, and markets were mostly weaker. Gilt edged still shrank, and Consols lost $\frac{1}{8}$ for money, closing at $74\frac{5}{8}$ to $74\frac{7}{8}$—a fall of $\frac{1}{8}$ in the week. Rails were irregular, American in poor case, and Foreign calm and quiet. In the Money Market, the continued relaxation culminated on Thursday in the lowering of the Bank rate to $4\frac{1}{2}$ per cent.; and the ease at the close was pronounced. Business in the Gas Market showed a clear increase in point of volume; some issues being more than usually conspicuous. Changes in quotation in the London Market were few but favourable, and the general characteristic was firmness; but on the local Exchanges one or two Provincial undertakings were rather easier. In Gaslight and Coke issues, the ordinary was very steady; transactions being within the limits of $102\frac{3}{4}$ and $103\frac{1}{4}$. In the secured issues, the maximum realized from 81 to $82\frac{3}{8}$, the preference from $96\frac{1}{2}$ to 97 (a rise of $\frac{1}{2}$), and the debenture from $73\frac{1}{4}$ to $74\frac{3}{4}$—also a rise of $\frac{1}{2}$. South Metropolitan was more active at firm figures, ranging from 112 to 113. The debenture made $74\frac{1}{2}$. In Commercials, there was only one deal in the 4 per cent. at 105. Among the Suburban and Provincial group, Alliance and Dublin changed hands at 75 to $75\frac{7}{8}$, Brentford old at $262\frac{1}{2}$, South Suburban at $117\frac{1}{2}$ and $118\frac{1}{4}$, and Tottenham "B" at 117. On the local Exchange, an odd lot of Newcastle went for 98—a fall of $\frac{1}{2}$. In the Continental companies, Imperial marked from 172 to 174, Union from 84 to 85, and European from $17\frac{13}{16}$ to $18\frac{1}{4}$. Among the undertakings of the remoter world, Monte Video was done at $12\frac{3}{4}$, Oriental at $130\frac{1}{2}$, Primitiva at $6\frac{3}{4}$ to 7 (a rise of $\frac{1}{4}$), ditto preference at 5 to $5\frac{1}{8}$ (a rise of $\frac{1}{8}$), ditto debenture at 96, San Paulo preference at $11\frac{1}{4}$ and $11\frac{3}{8}$, and ditto debenture at 49.

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
1,551,868	Stk.	April 11	5	Alliance & Dublin Ord.	74—77*	..	6 9 10
374,000	"	Jan. 16	4	Do. 4 p.c. Deb.	84—87	..	4 12 0
280,000	5	April 11	7½	Bombay, Ltd. . . .	6½—6¾*	..	5 11 1
50,000	10	Feb. 27	15	Bourne-) 10 p.c. . .	28½—29½	..	5 1 8
332,000	10	"	7	mouth Gas) B 7 p.c. .	15½—16½	..	4 6 8
75,000	10	"	6	and Water) Pref. 6 p.c.	13½—14½	..	4 4 3
880,000	Stk.	Feb. 27	14	Brentford Consolidated	260—265	..	5 5 8
330,000	"	"	11	Do. New . . .	200—205	..	5 7 4
50,300	"	"	5	Do. 5 p.c. Pref. .	113—115	..	4 6 11
206,250	"	Dec. 12	4	Do. 4 p.c. Deb. .	94—96	..	4 3 4
217,380	Stk.	Feb. 27	11	Brighton & Hove Orig.	206—211	..	5 4 3
244,200	"	"	8	Do. A Ord. Stk. .	151—154	..	5 3 11
530,000	20	Mar. 28	12½	British	45—46	+1	5 8 8
120,000	Stk.	Dec. 30	4	Do. 4 p.c. Deb. Stk.	89—91	..	4 7 11
245,771	Stk.	"	4	Buenos Ayres 4 p.c. Deb.	91½—93½	..	4 5 7
100,000	10	"	—	Cape Town & Dis., Ltd.	2—3	..	—
100,000	10	—	—	Do. 4½ p.c. Pref. .	4—5	..	—
100,900	Stk.	Dec. 30	4½	Do. 4½ p.c. Deb. Stk.	78—83	..	5 8 5
157,150	Stk.	Feb. 13	5	Chester 5 p.c. Ord. .	109—111	+1½	4 10 1
1,513,280	Stk.	Feb. 27	5/9/4	Commercial 4 p.c. Stk.	104—106	..	5 3 1
£560,000	"	"	5¼	Do. 3½ p.c. do. .	101—103	..	5 3 6
475,000	"	Dec. 12	3	Do. 3 p.c. Deb. Stk.	71—73	..	4 2 2
800,000	Stk.	"	4	Continental Union, Ltd.	84—87	..	4 12 0
200,000	"	"	7	Do. 7 p.c. Pref.	130—132	..	5 6 1
492,270	Stk.	—	5¼	Derby Con. Stk. . . .	124—125	..	4 12 0
55,000	"	"	4	Do. Deb. Stk. .	103—105	..	3 16 2
1,002,180	10	Jan. 16	10	European, Ltd. . . .	17½—18½	..	5 8 1
16,415,840	Stk.	Feb. 13	4/17/4	Gas-) 4 p.c. Ord. . .	101½—103½	..	4 14 2
2,600,000	"	"	3½	light) 3½ p.c. max. .	80—83	..	4 4 4
4,062,235	"	"	4	and) 4 p.c. Con. Pref.	96—98	+½	4 1 8
4,671,850	"	Dec. 12	3	Coke) 3 p.c. Con. Deb.	73—75	+½	4 0 0
258,740	Stk.	Mar. 13	5	Hastings & St. L. 3½ p.c.	89—91	..	5 9 11
82,500	"	"	6½	Do. do. 5 p.c.	—	..	—
70,000	10	Oct. 11	11	Hongkong & China, Ltd.	17—17½	..	6 5 9
131,000	Stk.	Mar. 13	7½	Ilford A and C . . .	152—155	..	4 18 4
65,780	"	"	6½	Do. B	120—122	..	5 0 5
65,500	"	Dec. 30	4	Do. 4 p.c. Deb. . .	89—91	..	4 7 11
4,940,000	Stk.	Nov. 14	9	Imperial Continental .	171—176	..	5 2 3
1,235,000	Stk.	Feb. 13	3½	Do. 3½ p.c. Deb. Red.	85—87	..	4 0 6
200,242	Stk.	Mar. 13	6	Lea Bridge Ord. 5 p.c. .	120—123	..	4 17 7

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
561,000	Stk.	Feb. 27	10	Liverpool United A .	215—217	−3	4 12 2
718,100	"	"	7	Do. B .	154—156	−1	4 9 9
306,083	"	Dec. 30	4	Do. Deb. Stk.	98—100	..	4 0 0
63,480	Stk.	Jan. 16	3	Maidstone 3 p.c. Deb. .	68—70	..	4 5 9
75,000	5	Nov. 28	6	Malta & Mediterranean	4⅛—4⅜	..	6 6 4
250,000	100	April 1	4½	Met. of) 4½ p.c. Deb. Melbourne)	98—100	..	4 10 0
541,920	20	Oct. 30	8½	Monte Video, Ltd. . .	12⅜—13½	..	5 5 8
1,775,892	Stk.	Feb. 27	4½	Newc'tle&G'tesh'd Con.	98—99	−½	4 10 11
529,705	Stk.	Dec. 30	3½	Do. 3½ p.c. Deb.	85½—86½	..	4 0 11
55,940	10	Feb. 27	7/7/0	North Middlesex 7 p.c.	13—14	..	5 4 7
300,000	Stk.	Nov. 28	8	Oriental, Ltd. . . .	127—132	..	6 1 3
60,000	5	Mar. 28	10	Ottoman, Ltd. . . .	8—8⅛	..	5 17 8
60,000	50	Feb. 27	13	Portsea, Island B . .	125—128	..	5 1 7
100,000	50	"	12	Do. C . .	122—125	..	4 16 0
249,980	5	Oct. 11	8	Primitiva Ord. . . .	6¾—7¼	+¼	5 10 4
499,960	5	Dec. 30	5	5 p.c. Pref. .	5—5⅛	+⅛	4 15 3
521,600	100	Dec. 2	4	" 4 p.c. Deb. .	96—98	..	4 1 8
346,198	Stk.	Dec. 30	4	River Plate 4 p.c. Deb.	92—94	..	4 5 1
275,000	5	Apl. 11	12	San Paulo, Ltd. . . .	—	..	—
150,000	10		6	Do. 6 p.c. Pref. .	11½—11¾*	..	5 2 2
125,000	50	Jan. 2	5	Do. 5 p.c. Deb. .	49—51	..	4 18 0
135,000	Stk.	Mar. 13	10	Sheffield A	224—226	..	4 8 6
209,984	"	"	10	Do. B	223—225	..	4 8 11
523,500	"	"	10	Do. C	224—226	..	4 8 6
90,000	10	Sept. 27	7½	South African	10—11	..	6 16 4
6,429,895	Stk.	Feb. 13	5/9/4	South Met., 4 p.c. Ord.	112—114	..	4 15 10
1,895,445	"	Jan. 16	3	Do. 3 p.c. Deb.	73—75	..	4 0 0
209,830	Stk.	Feb. 27	8½	South Shields Con. Stk.	161—163	..	5 4 4
952,795	Stk.	Feb. 27	6	S'th Suburb'n Ord. 5 p.c.	117—119	..	5 0 10
60,000	"	"	5	Do. 5 p.c. Pref. .	115—117	..	4 5 6
117,058	"	Dec. 30	5	Do. 5 p.c. Deb. Stk.	117—119	..	4 4 0
594,740	Stk.	Nov. 14	5	Southampton Ord. . .	102—105	..	4 15 3
120,000	Stk.	Feb. 13	7½	Tottenham) A 5 p.c. .	139—142	..	5 2 1
483,940	"	"	6½	and) B 3½ p.c. .	115—117	..	4 18 3
149,470	"	Dec. 30	4	Edmonton) 4 p.c. Deb.	92—94	..	4 5 1
182,380	10	"	5	Tuscan, Ltd.	5—6	..	8 6 8
149,900	10	Jan. 2	5	Do. 5 p.c. Deb. Red.	96—98	..	5 2 0
236,476	Stk.	Feb. 27	5	Tynemouth, 5 p.c. max.	115—116	..	4 6 2
255,636	Stk.	Mar. 13	6½	Wands-) B 3½ p.c. .	137—140	..	4 18 2
85,766	"	Dec. 30	3	worth) 3 p.c. Deb. Stk.	68—70	..	4 5 9

Prices Marked * are "Ex. Div."

WANTED, FOR SALE, CONTRACTS, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Appointments, &c., Vacant.

ENGINEER. Rochester, &c., Gas Company. Applications by May 8.
REPRESENTATIVE. Keith and Blackman Company, 27, Farringdon Avenue, E.C.
DISTRICT INSPECTOR. No. 5725.
TRAVELLER. "W. N.," 11, Houston Road, Forest Hill, S.E.
DRAUGHTSMAN. No. 5723.
DRAUGHTSMAN. No. 5724.
JUNIOR DRAUGHTSMAN. No. 5726.
WORKING MANAGER. Bradford-on-Avon Gas-Works.

Appointments, &c., Wanted.

LEADBURNER. No. 5715.

Financial Assistance Wanted. (Company Formation). No. 5727.

Plant, &c. (Second-Hand), For Sale.

GASHOLDER. Cambridge Gas Company.

Patent Licences, &c.

ACETYLENE GENERATORS. F. W. Golby, 36, Chancery Lane, W.C.
INCANDESCENT BODIES. Hubers and Mond, 19, Southampton Buildings, Chancery Lane, W.C.
MANTLES. W. G. Potter, 45, Monsell Road, Finsbury Park, N.

Stocks and Shares.

ASCOT GAS AND ELECTRICITY COMPANY. London Mart. May 6.
BOGNOR GASLIGHT AND COKE COMPANY. London Mart. May 6.
GREAT YARMOUTH WATER COMPANY. London Mart. May 6.
SUTTON GAS COMPANY. London Mart. May 6.
SWANSEA GASLIGHT COMPANY. By Auction. Hotel Metropole, Swansea. May 6.
WANDSWORTH, &c., GAS COMPANY. London Mart May 20.

TENDERS FOR

Benzol, Crude (Wanted). No. 5718.

Coal.

BELFAST GAS DEPARTMENT. Tenders by May 1.
BIRKENHEAD CORPORATION. Tenders by April 24.
BRECON GAS COMPANY. Tenders by May 6.
BROADSTAIRS GAS COMPANY. Tenders by May 7.
FORFAR GAS CORPORATION. Tenders by May 8.
RAMSGATE CORPORATION. Tenders by May 12.
RHYL URBAN DISTRICT COUNCIL. Tenders by May 5.
ROTHWELL GAS DEPARTMENT. Tenders by April 29.
SALFORD GAS DEPARTMENT. Tenders by May 1.
SOUTH SUBURBAN GAS COMPANY. Tenders by May 5.
STOKE-ON-TRENT GAS DEPARTMENT.
WORKINGTON CORPORATION. Tenders by May 5.

Compressing Plant and Governors.

NEW MILLS DISTRICT COUNCIL. Tenders by April 26.

General Stores (Sulphuric Acid).

FORFAR GAS CORPORATION. Tenders by May 8.

Meters.

FORFAR GAS CORPORATION. Tenders by May 8.

Pipes, &c.

FORFAR GAS CORPORATION. Tenders by May 8.
MORECAMBE GAS DEPARTMENT. Tenders by May 3.

Purifier and Scrubber Alterations, &c.

BRIDGNORTH GAS DEPARTMENT. Tenders by May 3.

Tar, Liquor, and Other Residuals.

FORFAR GAS CORPORATION. Tenders by May 8.
RHYL URBAN DISTRICT COUNCIL. Tenders by May 5.
STOKE-ON-TRENT GAS DEPARTMENT. Tenders by May 7.